METHODOLOGICAL, THEORETICAL AND EMPIRICAL CONSIDERATIONS IN THE ANALYSIS OF THE DETERMINANTS OF AGGREGATE HEALTH CARE EXPENDITURES IN OECD COUNTRIES, 1960 – 1997

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Abstract

Health care now accounts for just under 10% of national income in most developed OECD countries. Yet, despite its importance in the overall economy, the factors that drive health care expenditure remain only imperfectly understood. This thesis shows that the determinants of health care expenditures are simply too diverse amongst different countries to be brought within a common denominator such as GDP, as it has been argued for decades. It also shows that the assumption that health care is a homogeneous good across countries is over-simplistic and arbitrary, and finds ample evidence showing that health care is not a luxury good, as widely suggested. The contribution of the thesis is on methodological, theoretical and empirical grounds.

In terms of methodology, the thesis shows that there are significant flaws in several areas that influence our thinking concerning the determinants of health care expenditures and offers alternative ways of analysis and appraisal. Flaws were shown in: the relationship between health expenditure and GDP; the importance of factors such as ageing; the macroeconomic context and the burden of disease; the measurement of key variables used in empirical analysis such as health spending, national income, technology, and health prices; the method of analysis that has been pursued; and the conversion factors used to translate prices and monetary variables across countries into a single and comparable denominator.

The thesis makes a theoretical contribution of the analysis of health care expenditures, assuming that health care is at least a quasi-public good. The proposed conceptual framework explicitly links the determinants of health care expenditures to the theory of public finance and allows flexible adjustments by decision-makers to account for changes in technology,

prices, and the macroeconomic environment. The impact of the macroeconomy on health spending is assessed by evaluating whether the *rate of growth of income* has any influence on the demand for health and whether the *fiscal deficit* impacts on health spending and to what extent. The proposed framework incorporates technology and this is an advance from the published literature, which has almost invariably considered technology to be a residual factor. Finally, the thesis recognises that the lag structure of the model, the availability of data, and knowledge of the relationship between disease and need for services are not sufficient to test for the impact of lifestyle and disease factors on health spending.

The empirical investigation provides conclusive evidence of the non-importance of GDP in explaining health care spending trends over time. Consumption is shown to be a predictor of health expenditures; technology is an important cost-push factor across countries; the macroeconomy exerts, in general, significant pressure on health care expenditure; however, the impact of health care reforms does not show any significant impact on health care expenditures; and the number of doctors per capita has little or no association with health care expenditures.

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Abbreviations

ADF	Augmented Dickey Fuller test
AR(1)	First Order Autoregressive Process
ARCH	Autoregressive Conditional Heteroscedasticity
ARMA	Autoregressive Moving Average process
CPI	Consumer Price Index
DRG	Diagnosis Related Group
DW	Durbin Watson statistic
EC	European Community
ECM	Error Correction Model
ECT	Error Correction Term
EG	Engel-Granger
EMS	European Monetary System
ERM	Exchange Rate Mechanism
ESSPROS	European Systematic Approach of Social Protection
EU	European Union
FES	Family Expenditure Survey
GDP	Gross Domestic Product
GEM	Global Econometric Model
GNP	Gross National Product
GP	General Practitioner
HCE	Health Care Expenditures
HMO	Health Maintenance Organisation
IFS	International Financial Statistics

ILO	International Labour Office
IMF	International Monetary Fund
IPS	Im-Pesaran-Shin test
MDR-TB	Multi-drug resistant tuberculosis
MoH	Ministry of Health
MRI	Magnetic Resonance Imaging
MRSA	Methicillin resistant staphylococcus aureus
NCU	National Currency Unit
NIESR	National Institute of Economic and Social Research (UK)
NHS	National Health Service
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
OTA	Office of Technology Assessment (USA)
OTC	Over the counter medicines
PAHO	Pan American Health Organisation
PAYG	Pay As You Go
PPO	Preferred Provider Organisation
PPP	Purchasing Power Parity
R&D	Research and Development
SEM	Structural Equation Model
SNA	System of National Accounts
VAR	Vector Autoregression
VAT	Value Added Tax
VHI	Voluntary Health Insurance
WHO	World Health Organisation

CHAPTER 1 INTRODUCTION

1.1 Background

This thesis is about paying for health care. Health care now accounts for just under 10% of national income in most OECD countries. For many years health care spending rose faster than national income itself, although more recently it has stabilised in many countries (Table 1.1) although at the expense of shortages, rationed services and queues in some. Yet, despite its importance in the overall economy, the factors that drive health care expenditure remain only imperfectly understood.

Other than the USA, health care in industralised countries is predominantly publicly funded and the share of public spending on health exceeds 65 percent of the total outlays (see Table 1.2). The main methods of financing health services are from social insurance contributions or general taxation, except in the USA and (until recently) Switzerland, where voluntary health insurance contributions are the main sources of health service finance[1], albeit with considerable government involvement. Additional funds come from patient contributions in terms of co-payments, co-insurance, and/or deductibles.

The central role of government, even in the USA and other countries that have a significant private health insurance sector, shows how the funding of health care is, among other things,

[1] In Germany and the Netherlands, there exists the possibility for high earners to opt out of the publicly funded health insurance system and contract with a private insurer. This is nevertheless optional and a significant proportion of those who can opt out of the publicly funded system, opt not to do so. Switzerland also has a significant public sector financed predominantly out of social insurance contributions, particularly after 1996, when the revised health insurance law came into force, requiring all permanent Swiss residents to purchase compulsory health insurance policies for which the premiums are community- rather than risk-rated (as was the case in the pre-1996 era). In other countries, the out-of-pocket element is quite significant (Greece, Italy, Portugal).

a macroeconomic issue and relates to the availability of resources and their distribution among various activities by government and those acting on its behalf. The same applies to the US and Switzerland for the part that is publicly financed. For the part that is not publicly financed, the key issue relates to setting insurance premia and the extent to which these can increase without affecting employees' willingness to pay and affordability, and employers' competitive position in the market.

Table 1-1 Health care as a % of GDP (1970 - 2000)

Countries	1970	1980	1985	1990	1995	1998	1999	2000
Austria		7.7	6.4	7.2	8.7	8.2	8.3	
Belgium		6.6	7.2	7.7	8.1	8.8		
Denmark		9.1	8.9	8.2	8.2	8.3	8.3	
Finland		6.5	7.1	8.1	7.1	6.9	6.8	
France		7.4	8.1	8.8	9.5	9.6	9.4	
Germany	6.2	8.7	8.9	8.7	10.2	10.6	10.5	
Greece		6.7		7.6	8.1	8.3	9.3	8.7
Ireland		8.6	7.6	7.1	7.3	6.4	6.1	
Italy	5.2	7.3	6.9	8.2	7.8	8.4	8.4	
Japan	4.6	6.6	6.7	6.2	7	7.6		
Luxembourg						5.9	6.1	
Netherlands		8.1	7.8	8.6	8.8	8.6	8.7	8.1
Portugal	2.7	5.9	5.9	6.6	7.7	7.8		
Spain	3.6	5.2	5.4	6.9	6.9	7.1		
Sweden			8.7	8.7	8	8.4		
Switzerland				8.5	9.4	10.4		
U.K.		5.6	5.8	6.2	6.9	6.7	7	
USA	6.8	8.6	10	12	13.1	13.6	13.7	
Australia		7.4	7.8	8	8.5	8.5		
Canada		7.2	8.3	9.1	9.1	9.5	9.5	

Source: OECD Health Database, 2001.

A major reason for the attention that health care expenditure has attracted over time is the significant upward pressure on health care costs in most developed countries. Health spending has often risen much faster than GDP. Furthermore, pharmaceutical spending, a key part of health spending, has often increased faster than either GDP or overall health spending, particularly after 1980 (OECD Health Data, 2000).

The rate of increase in health care costs is an important issue because all resources are scarce and must be used rationally and efficiently. This is a traditional problem of optimal resource allocation under a budget constraint [2]. Although this has always been the case in economic decisions, where demand (or desire) always exceeds supply (or availability of resources), two developments have made the problem of increasing health care spending more difficult to address.

The first was the realisation that economic growth in most OECD countries slowed down significantly in the 1980s compared with the euphoric 1960s and the first half of the 1970s. At the same time, governments have had to implement counter-cyclical fiscal measures to neutralise the effects of negative growth when in recession, and pursue fiscally prudent policies that would restore a balanced budget when in a boom. At the same time, it appears that upward pressure on health spending has not slowed down – quite the contrary. While growth in health spending in the 1960s could be more than offset by GDP growth, this was not the case in the 1980s and much of the 1990s. Many hypotheses have been put forward regarding the reasons for the escalation of health care costs, including the ageing of the population (Abel Smith, 1996), the impact of new technology (Evans, 1983), the intensity of the services provided (US Congress, 1997), and also the relationship between income and the demand for health (Abel Smith, 1963; Abel Smith, 1967).

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[2] Optimal resource allocation can be interpreted in terms of technical or allocative efficiency. Within the context of health care, the former means that maximizing health gain subject to a budget constraint, would result in societal losses, i.e. some individuals would lose out. Within the same context, the latter implies that scarce resources can be used in such a way so as to maximize health gain from their use without societal losses. The concept of allocative efficiency underpins Pareto optimality.

Table 1-2 Public and Private Health Care expenditure as a % of total Health Care Expenditure: 1970 – 1999

Countries	1970		1980		1990		1995		1999	
	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private
Austria	63.0	37.0	68.8	31.2	73.5	26.5	72.3	27.7	72.1	27.9
Belgium	87.0	13.0	83.4	16.6	88.9	11.1	69.9	30.1	71.3	28.7
Denmark	NA	NA	87.8	12.2	82.6	17.4	82.6	17.4	82.2	17.8
Finland	73.8	26.2	79.0	21.0	80.9	29.1	75.5	24.5	75.7	24.3
France	74.7	25.3	78.8	21.2	78.2	21.8	77.7	22.3	78.1	21.9
Germany	72.8	27.2	78.7	21.3	76.2	23.8	78.1	21.9	75.3	24.7
Greece	42.6	57.4	55.6	44.4	62.7	37.3	54.5	45.5	56.8	43.2
Ireland	81.7	18.3	81.6	18.4	71.7	28.3	72.5	27.5	77.1	22.9
Italy	86.9	13.1	80.5	19.5	78.1	21.9	67.4	32.6	68.0	32.0
Luxemburg	88.9	11.1	92.8	7.2	93.1	6.9	92.4	7.6	92.9	7.1
Netherlands	NA	NA	69.2	30.8	67.7	32.3	72.0	28.0	68.5	31.5
Portugal	59.0	41.0	64.3	35.7	65.5	34.5	65.3	34.7	66.9	33.1
Spain	65.4	34.6	79.9	20.1	78.7	21.3	78.0	22.0	76.9	23.1
Sweden	86.0	14.0	92.5	11	89.9	10.1	85.2	16.8	83.8	16.2
Switzerland	57.8	42.2	63.3	69.4	68.4	31.6	72.3	27.7	73.4	26.6
U.K.	87.0	13.0	89.4	9.9	84.3	15.7	84.9	15.1	83.3	16.7
USA	36.3	63.7	41.5	58.5	39.6	60.4	45.6	54.4	44.5	55.5
Australia	67.4	32.6	62.8	37.2	67.4	32.6	67.4	32.6	69.3	30.7
Canada	69.9	30.1	75.6	24.4	74.6	25.4	71.2	26.2	70.6	29.4
New Zealand	80.3	19.7	88.0	12.0	82.4	17.6	77.2	22.8	77.5	22.5

Source: OECD Health Database, 2001.

The second consideration was that economic policy-makers had to take tough decisions in the light of ever increasing pressure on health spending in relation to sluggish GDP growth. Other priorities existed which were given as much importance as health in the light of changing circumstances. An emphasis on investment in education, vocational training, and technology are prime examples of the changing paradigm in international competition and the determinants of competitiveness of nations. Under these circumstances, cost containment and the search for macro-efficiency and micro-efficiency have been the cornerstones of health care reform in developed countries (OECD, 1992; OECD, 1994; Mossialos & Legrand, 1999).

All these make the achievement of health systems goals resemble a constrained maximisation problem as shown in Box 1, where the maximisation of health status is subject to four constraints: firstly, a resource constraint, stemming from macroeconomic budgetary limitations; secondly, a welfare system constraint, arising from difficult choices in allocating scarce resources between "competing" welfare services, which present equally pressing needs (e.g. pensions and education); thirdly, a health challenges constraint, originating from evolving patterns in lifestyles and the incidence of disease and new, and often more complex, ways of responding to disease; and, finally, a constraint relating to consumer expectations, arising from the pressures that rising expectations impose on what consumers/patients expect health services should cover and deliver.

Box 1

The Problem of further Improving the Health Status

of EU Populations

Maximising Health Status

subject to:

a. macroeconomic constraint

b. welfare system constraint, excluding health

c. health challenges constraint

d. consumer expectations

There are two aspects of the macroeconomic constraint: a supply aspect and a demand aspect. On the supply-side, the macro economy has been unable to deliver consistently high growth rates, which makes the pursuit of fiscal prudence essential in order to maintain macroeconomic balance. This also includes additional exogenous factors, such as the introduction of a single currency in European Union countries, which has necessitated the implementation of tight fiscal and monetary policies in the Euro-zone, in the period prior to its launch (Kanavos & McKee, 1998). On the demand-side, health systems face the challenge of providing care for ever increasing need, although the often cited infinite need may be a myth according to some (Frankel, 1991). For many health systems, the 1960s and 1970s were the decades of expansion with expansion to universal coverage in several developed countries while extending coverage and introducing further choice in others (OECD, 1994). At the same time as countries increased coverage and attempted to increase responsiveness to population needs, they faced the need to contain costs as the demand for health care kept rising faster than the rate of increase in total income. Consequently, cost containment and the pursuit of micro-efficiency have been two of the most important thrusts in health policy making over the last two decades and, as a result, health care in many developed countries has become more "managed" (Mossialos, Kanavos & Abel Smith, (1997); Mossialos & LeGrand, (1999)).

There are also lateral pressures on publicly funded health systems, particularly those arising from the funding of other welfare services which are part of the national budget and have also seen their share of GDP increasing over time. Publicly funded pension schemes (Pay As You Go – PAYG) are an interesting case in this respect because they will almost certainly exert considerable pressure on national resources in the near future for two reasons: firstly, because the ratio of contributors to beneficiaries in PAYG schemes is changing as populations age in the developed world, and that questions the sustainability of current schemes and their modes of funding; secondly, the current level of provision of public pension systems, in some countries, may imply that for similar benefits to accrue to future pensioners, contribution rates will have to rise considerably with severe implications for employment costs. It has been estimated that most industrialised nations will need considerably higher contribution rates to sustain current patterns of benefits (Chand & Jaeger, 1996). For instance, significant pressure exists on public finances from PAYG schemes as a proportion of GDP in countries such as Germany, France and Italy compared with the US and the UK, which rely predominantly on funded schemes [3] (Kanavos & McKee, 1998). However, it is also true that volatility in global capital markets poses severe problems for countries with predominantly funded systems, so that PAYG may become more important in countries that have reduced its importance, if widespread poverty in old age is to be avoided.

Health challenges are equally important and increasingly complex. Developed countries face changing patterns of disease, with major implications for health services (Kanavos & McKee, 1998). There are two such challenges. First, some infectious diseases, most obviously HIV, pose a considerable threat to the extent that there are few or no effective cures. In addition, there is growing resistance to antibiotics, for instance, methicillin resistant staphylococcus aureous (MRSA), multi-drug resistant tuberculosis (MDR-TB), and trimethoprim-resistant salmonella. Antibiotic resistance is not new, but what is new is the scale of the problems (Orton, 1997). The cost implications of these developments include the need for more costly antibiotics, the need for additional drug testing, and for more prolonged hospital stays, as well as the use of isolation facilities.

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[3] Of course, pressure would increase also in the case of fully funded systems if financial markets tumble and display zero growth for long periods of time, which may cause pension fund companies to collapse. The role of government in this case is to have set in place an adequate regulatory framework to predict these situations and avoid crises from occurring.

Second, many non-communicable diseases, such as diabetes and conditions of the central nervous system are gaining in importance. These reflect ageing populations and changes in lifestyle. The co-existence of neuro-degenerative disease has important implications for the cost of providing care for many other disorders. (Gray & Fenn, (1993); Gray, (1995); Chisholm, Knapp et al., (1997); Freer, (1985); Kind & Sorensen, (1993); McCrone & Weich, (1993); Torgenson, Donaldson et al., 1996)) as populations in the developed world age gradually and available treatments are more palliative than curative. Finally, traffic accidents present a major cause of death in the age groups of 25-44 years (Atlas of Avoidable Deaths, EC, 1997). For example, Greece and Portugal present death rates which are three to four times higher than the rest of the North of Europe. A considerable proportion of these deaths could be prevented if the emergency care system could function more effectively.

In the light of the above discussion, it is clear that an understanding of the determinants of health expenditures lies in the identification of factors that affect them over time within individual countries and the implications for policy that targeting of these factors would have. Some countries such as the UK have begun incorporating the future impact of health, fiscal and macroeconomic challenges into their decision-making process with a view to planning strategically their health care resources (Wanless Report – UK Treasury, 2002).

1.2 The purpose of this thesis

1.2.1 Methodological and policy imperatives

The previous section has outlined briefly a number of simple observations linking health spending and certain variables, notably income, as measured by GDP, other macroeconomic factors (for instance levels of deficit, debt and inflation), health system-related factors, population ageing, lifestyles (for instance aspects of diet, tobacco and alcohol consumption), technology, and epidemiology, among others. Over the past two decades or so, upward pressure on health care expenditures has placed health policy firmly on the political arena in the majority of developed countries. As a result, there is increased interest in comparing results within countries, but also, increasingly, across countries. International comparisons of health care expenditures and their determinants go back to the early 1960s but have since been used more widely. This interest has intensified over the past two decades.

Nevertheless, simple one-way observations at a specific point in time can say little about the determinants of health care expenditures within a country over time, let alone a group of countries. They may allow general cross-country comparisons about the share of national resources expended on health, but they do not reveal anything about the extent to which these resources are sufficient to meet their objective or are efficiently used. Furthermore, they ignore the robustness of the models and comparability of the data. Thus, they are observations reflecting the casual link between variables without being placed in a conceptual framework. However, doing this can have the effect of reducing domestic political debate about the adequacy of health spending within any particular country to a banal level (Judge, 1997), essentially deflecting attention away from more informative analyses that would focus attention on the determinants of variations in the coverage and composition of health services, including micro-efficiency and resource allocation (Kanavos & Mossialos, 1999).

Despite reservations, frequently expressed in the literature, about the benefits of comparative studies (Klein, (1991); Abel-Smith, (1994); Judge, (1997)), a stream of research has emerged where the use of cross-sectional or pooled data has resulted in three main findings (Kanavos & Mossialos, 1997): Firstly, income, measured by gross domestic product (GDP) per capita, is the single most important determinant and predictor of health care expenditure and the income elasticity of demand for health care exceeds unity, which effectively means that health care is a luxury good. Secondly, as countries move towards higher levels of industrialization, the share of GDP spent on health care rises; this implies that health care expenditures may be increasing ad infinitum. And thirdly, a more detailed analysis of the determinants of health care expenditures has suggested that, regardless of the method, type of model and variables used, the key results remain robust over time.

1.2.2 Taking the debate further

Within this framework, the thesis will take the debate further than where it currently stands and will contribute to the literature on the determinants of health care expenditures on three counts: firstly, in conceptual and theoretical terms, secondly, in terms of methodology and of statistical analysis, and, thirdly, in terms of inferring the policy relevance of the results produced. In doing so, it investigates the extent to which macroeconomic, organisational, technological, demographic and lifestyle factors play a role in explaining levels of spending on health in individual countries and in groups of similar countries. By examining the relationship between these variables and health spending over a period of time, the thesis also aims to unveil the dynamics of factors influencing health spending. Finally, the thesis aims to identify whether the same factors have similar effects across a number of countries in the developed world.

Concerning the first element identified above, the thesis will build a demand function for health care and analyse the difficulties in estimating it, both within as well as across countries. In doing so, the thesis will seek to identify a theoretical foundation for analyzing this demand function. In any analysis it is important to establish a conceptual framework and examine to what extent these concepts can be operationalised to provide the critical link between empirical observations and developments in health care systems. Comparative analysis can arrive inductively at a theory after a lengthy examination of evidence from multiple countries, permitting generation and testing of a hypothesis (Rose, 1991). However, the empirical analysis of the relationship between health expenditure and GDP has never been linked to a theoretical framework. In the existing analyses, all health expenditure, both public and private, is treated as a behavioural variable, similar to private consumption and expenditure. To some extent, therefore, the results are based on an empirical observation that largely reflects Wagner's Law, namely that an increase in national income causes an increase in public expenditure, mainly through an increase in demand for public services. But clearly, "the diverse institutional and regulatory features of a health care system cannot be captured fully by a simple measure of that kind" (Leidl, 1998). An additional conceptual problem is that authors use aggregate macroeconomic demand functions, while the interpretation of the results has usually been based on foundations of microeconomic theory. This assumes the possibility of summing all linear household demand equations to a single total market demand equation. While this is possible, it can only be fulfilled under certain rather strict conditions, assuming, among others, the same or similar consumption rates for all households, the same or similar public/private mix, and the same or similar mix of health services across countries. Consequently, the interpretation of income elasticities of demand should be treated with caution, as it does not necessarily follow that whatever is found at the microeconomic level is going to be replicated at the macroeconomic level (Deaton & Muellbauer, 1980).

Second, the thesis will make a contribution in terms of methodology and estimation of the determinants of health care expenditures. Aside from the theoretical foundation and conceptual framework, the validity of an empirical observation relies greatly on the credibility of the data, the method used and the robustness of the analysis. The quantitative literature on the determinants of health care expenditures raises a number of important methodological issues pertaining to the data and their comparison across countries, the type of conversion factor employed (exchange rates or Purchasing Power Parities – PPPs) when performing cross-section or pooled cross-section analysis, the prices of health services inputs, and the method of estimating health production functions. The thesis will analyse these pitfalls, and by using data similar to those that have already been used in the literature it will, first of all, offer an alternative but robust methodology of estimating the determinants of health care expenditures, secondly, it will show that there are variables whose importance has been ignored to date, and, thirdly, it will arrive at results that are strikingly dissimilar to the ones that have already been produced. Furthermore, a taxonomy of potential determinants of health expenditure will be provided, together with suggestions for their inclusion in empirical analysis. An additional aim of the thesis is to emphasise the importance of methodological issues when conducting international comparisons of determinants of health care expenditures and to contribute to the discussion on the development of a theoretical framework.

Third, the thesis will explore the policy implications of the methodological and empirical findings, particularly those that have been concerned with health care being a luxury or a necessity. The policy implications have rarely been explored in the literature[4] and few explanations have been given as to what health care being a luxury actually means in applied policy terms. The thesis will take on board findings such as the one that follows:

[4] One such case is Newhouse (1993), Health Economics, where the care vs. cure argument is discussed as a likely interpretation of an income elasticity of demand greater than unity. Even in this case though, practical policy conclusions are not derived.

"... Demand for health services has been increasing consistently over the past thirty years more than national income in real terms, whilst at the same time real GDP growth rates have fallen considerably in the 1980s and 1990s compared with the 1960s and 1970s. The differences in the expansionary process of health care expenditures in conjunction with GDP growth, are reflected in income elasticities of demand for health care. In Europe, for instance, during the period from 1960 to 1970 this elasticity was 1.37 implying faster expansion of the health sector in comparison to the average economic growth. This was also combined with strong economic growth in all European countries. In the 1970s the two oil shocks and the ensuing recession contributed to the average income elasticity of demand for health care in Europe falling to 1.25. Finally, the 1980s brought a new era in the international health systems by imposing cost control and cost containment policies. The expansionary process of health expenditures was further curtailed in Europe where the corresponding income elasticity of demand averaged 1.08 (OECD, 1995). Meeting therefore an ever increasing demand for health services from a total pool of resources which does not grow as fast, contributes to the national economies' budget deficits and overall indebtedness ...".

The validity of these findings will be considered and, in addition, answers will be proposed to a series of other questions, as follows:

- What are the determinants of public and private health care expenditures? Does the conclusion that health care is a luxury good hold if we disaggregate total health care expenditure into public and private health care expenditure?
- Are there other determinants influencing the level of health care spending and if so what are they, and how do they affect spending? Are the factors that affect health spending common across countries, or are there qualitative differences among them?

How should empirical research account for the diversity of health systems in the empirical analysis of cross-country comparisons?

- On the basis of available results from the empirical literature, is it the case that health care spending will grow faster than GDP ad infinitum? Does current GDP growth reflect future changes in health spending? If this is true, is there a cut-off point beyond which health spending will stabilise? What factors would determine such a cut-off point and what is their relative importance?
- What are the results of implementing health care reforms in different countries? What is their dynamic impact on health care spending?
- Is there a theoretical framework which could, partly, explain the empirical observation of health expenditures rising faster than GDP? To what extent can the empirical findings contribute to policy developments?
- Is there a macroeconomic theory of determinants of health spending, based on the micro foundations of health care delivery?

These are important questions that the empirical literature has, at best, addressed only partly. The thesis will investigate the determinants of health care expenditures according to the framework set out above. Twelve developed countries, members of the Organisation for Economic Cooperation and Development (OECD) will form the basis of the analysis. The countries are: Austria, Belgium, Denmark, France, Germany, Finland, the Netherlands, Portugal, Spain, Sweden, Switzerland, and the UK. The statistical analysis benefits from a single-country model, as the only reasonable way of analyzing the determinants of health care expenditures over time and comparing the results across countries. With regards to time-series analysis, co-integration analysis is performed. Data have been used from the 2000 OECD Health Database, which allows estimation for the period 1960 through 1997. In addition, some macroeconomic data series from the International Monetary Fund's (IMF) International Financial Statistics (IFS) have been used.

1.3 Limitations of the analysis

The thesis offers a number of advances on the current literature on the determinants of health care expenditures. However, several limitations also exist. These, as well as an explanation of how they are tackled, are outlined below.

First, the analysis that follows is an aggregate macroeconomic analysis, rather than one examining the microeconomic determinants of health care expenditures, i.e. analyzing a health production function at a household level. Performing a microeconomic analysis would not be feasible within the remit of the current framework and would require a different approach and analytical framework, as, one of the objectives of the thesis is to introduce modifications to the current macro-economic models and test them empirically.

While the analytical framework is macroeconomic rather than microeconomic, the thesis recognizes that there is a discrepancy in the results obtained from each of the two approaches with regard to the determinants of health care expenditures, so that most studies at household level in developed countries do not show an income elasticity of demand greater than unity. Whilst recognizing this, the purpose of the analysis is not to perform a macro-micro comparison, nor to add to the debate as to why this discrepancy exists. Indeed, explanations for this discrepancy have already been offered and these are reviewed in chapter 2.

Second, by performing a time-series analysis, the availability of some data series is severely compromised, for instance, lifestyle and habit variables, which have a delayed impact on population health. While the non-availability of these variables is, in principle, problematic, from an econometric perspective their impact may already be captured by other variables used in the models. For instance, in the case of diet and lifestyle variables (e.g. fat intake per capita, tobacco, and alcohol consumption per capita), their impact on population health is delayed, but the precise lag structure is poorly understood. However, measures of mortality over the period under investigation (1960-1997), should reflect the composite effect of these factors to some extent.

Third, data on some variables (technology being an example) are not available over long periods of time, in which case proxies are being used. In this way, what is relevant is not excluded, but included with what is measurable.

1.4 Thesis outline

The thesis comprises 7 chapters in total, including the present, introductory chapter. Chapter 2 provides a literature review of the determinants of health care expenditures. The chapter explores the relevant literature on the determinants of health care expenditures that stretches as far back as the beginning of the 1960s and aims to provide a critical overview of the aggregate analyses of the determinants of health care expenditures over the period 1960-1999; to explore the way that the relationship between national health care expenditures and important economic, social, and demographic variables has emerged from the international literature over this period; and to evaluate the current thinking on the determinants of health care expenditures as well as identify outstanding gaps in our knowledge.

Chapter 3 provides an exposé of key methodological problems in the estimation of health care expenditures, both from a theoretical and an empirical perspective. In particular, it provides a critique of the theories that have been used to justify the empirical research and calls for a more robust theoretical framework; it assesses the relative advantages and disadvantages of different estimation methodologies (cross-sectional, pooled cross-sectional, and time-series analysis), that have been used to estimate determinants of health care expenditures, with a view to resolving the issues of robust empirical estimation and the availability of policy-relevant conclusions; it highlights the imperfect nature of existing conversion factors and discusses the usefulness of different conversion factors employed in cross-country comparisons; and it discusses the use of health prices and price indices in the literature, with a view to recommending an appropriate price index for cross-country comparisons.

Chapter 4 continues the discussion of methodological problems in the estimation of health care expenditures. In particular, chapter 4 analyses methodological problems in the measurement of key estimation variables, such as health expenditures and gross domestic product; it explores whether alternative and more robust measures of a country's income than gross domestic product can be identified; it critically appraises certain measures of population health status that are commonly used in econometric analyses such as mortality, life expectancy, and ageing from a conceptual perspective and discusses the extent to which these can be used from a methodological perspective; and it identifies further potential determinants of health care expenditures that have not been (widely) used in the literature (for instance, technology, and the impact of other macroeconomic factors).

Chapter 5 develops a theoretical framework that builds on the arguments developed in previous chapters. In doing so, it takes account of the theoretical and methodological points raised in chapters 3 and 4, establishes a theoretical framework for the aggregate determinants of health care expenditure and discusses ways of estimating it empirically. In particular, it develops the conceptual theoretical framework and empirical model; it presents the variables employed in the empirical model; it discusses the countries chosen for empirical analysis, the data sources and the estimation techniques that will be used; and it briefly summarises the theoretical and empirical advances made with the current framework.

Chapter 6 provides an empirical investigation of the theoretical model and hypotheses developed in chapter 5. Consistent with the hypotheses developed in chapters 3, 4, and 5, the analysis pursued in this chapter relies on time series, does not use any denominator for monetary values, and examines the determinants of health care expenditures on a country-by-country basis and for each of the 13 countries individually. Two streams of empirical investigation are followed in this chapter: the first includes GDP for purposes of comparison with the published empirical literature to-date, and also addresses empirically the question of whether health care is a luxury good, namely, whether the income elasticity of demand, measured by GDP, is greater than unity. The second pursues the inclusion of total consumption, as an alternative measure of national wealth and income, in the empirical investigation and is therefore consistent with the analytical framework presented in the chapter 5. The empirical evidence is also presented in two stages: the first presents conventional time-series analysis, in particular, the first order autoregressive correction, whereas the second builds on the theory of and empirical evidence on trends in time series and co-integration analysis.

Finally, chapter 7 draws the main conclusions of this thesis, provides a discussion of policy implications and highlights areas for future research on the subject.

CHAPTER 2 DETERMINANTS OF HEALTH CARE EXPENDITURES: A LITERATURE REVIEW

2.1 Introduction

To understand the determinants of health care expenditure it is necessary to begin with a review of the accumulated thinking on this topic so far. This chapter explores relevant literature that stretches as far back as the beginning of the 1960s. The objectives of this chapter are threefold: first, to provide a critical overview of the aggregate analyses of the determinants of health care expenditures over the period 1959-1999; second, to explore the way that the relationship between national health care expenditures and important economic, social, and demographic variables has emerged from the international literature over the past 40 years; third, to evaluate current thinking on the determinants of health care expenditures and identify outstanding gaps.

Section 2 of this chapter specifies the search strategy followed in obtaining the literature for this thesis, including the types of literature incorporated, the period under investigation, inclusion criteria and keywords. Section 3 traces the historical development of research on the topic and provides some general observations on the overall research results. It also discusses the quality of the data on which comparisons between countries are made. Section 4 examines literature on the statistical relationship between national income and health care expenditures and discusses the sensitivity of the results obtained to: (a) the type of analysis, namely cross-sectional, time series or pooled cross-sectional, and (b) the type of model employed. It also examines the increasing sophistication of models required to deal with growing numbers of variables, and defines explicitly the problems they seek to solve. Section 5 discusses the statistical relationship between health care expenditures and variables other than national income. Section 6 places the literature on the determinants of health care expenditures in developed countries, in a wider context by looking at its applicability to a developing country perspective. Section 7 analyses the use of conversion factors such as exchange rates and purchasing power parities (PPPs)[5] and the extent to which results obtained are sensitive to the use of each of these measures. Finally, section 8 draws together the main implications of this review.

2.2 Search methodology

In order to fulfil the above questions, the search strategy entailed three key elements: firstly, the identification of keywords, secondly, the selection of coverage, and thirdly, the selection of time period.

The following keywords were used:

- Determinants of health care expenditures
- Macroeconomics of health care
- Macro econometrics of health care
- Ageing and health care expenditures
- Technology and health expenditures
- International comparisons of health care expenditures
- Co-integration approach in health care
- Co-integration and determinants of health care expenditures
- Health production function
- Econometrics and health production function
- Income elasticity and health expenditures

5 Both Health-PPPs and GDP-PPPs. Purchasing Power Parities (PPPs) can provide a set of international exchange rates based on relatively stable country-to-country cost-of-living differences with respect to real services and commodities commonly available in the domestic economy of each nation. The GDP-PPP is based on a hypothetical common basket of goods, but other market baskets or specific individual comparison goods

- Demand for health care
- Health – GDP relationship

The coverage of the research is international, including both developed and developing countries, although, the analysis in subsequent chapters covers only a selection of developed countries. Finally, the period under investigation is 1959 - 2000. The following databases were searched:

- MEDLINE
- PUBMED
- BIDS/ISI
- CINAHL
- EMBASE
- EUROPA
- Additional (official) literature was obtained from the Office of Official Publications of the European Union and Statistics Netherlands.
- The catalogues of the London School of Economics and Political Science (LSE) and the London School of Hygiene and Tropical Medicine (LSHTM) Libraries were also searched and several book/chapter titles were obtained in this way.

The type of literature that emerged covered the range of possible publications, including:

- Articles in peer reviewed journals (health economics-related and health policy-related, both qualitative and quantitative)
- Books
- Chapters in books
- Official reports by international agencies (e.g. EU, ILO, OECD)

(also known as numeraires) would also provide possible bases for comparison. One such specific PPP is the

- Official reports by national governments
- Unpublished papers and reports both from government agencies and individual investigators

The literature has subsequently been categorized and appraised in terms of:

- First, the quality and robustness of the evidence (strong, moderate or weak) over time and across countries and
- Second, the relevance to the subject under investigation (high, medium, low)

Finally, common themes have been identified, in accordance with the above two appraisal criteria and gaps have also been identified in the existing evidence-base.

2.3 Historical context and general observations

2.3.1 Historical context

Information on health expenditures has evolved quite considerably over the past 40-45 years, mostly in developed countries and less so in developing countries. The earliest comprehensive international study was published in 1959 by the International Labour Organisation, and compared medical payments under social insurance schemes with payments under voluntary (private) health insurance schemes in the USA. Several years later Abel-Smith (1963, 1967) was the first to try to standardise cross-national data by defining the constituent components of health services, listing the main sources of finance, and laying down a standard classification of expenditures which he applied to 15 industrialised countries. These efforts were followed by some studies, comparative in nature (Simanis, 1973; Simanis, 1990), which led to the development of what is now known as the OECD Health Database. The database contains time-series information on health care expenditures, inputs to individual health systems, as well as some outputs, and is prepared using standard

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Health-PPP.

definitions (OECD, 1989; OECD, 1993) The database, which is now updated annually, relies on information supplied by the member countries of the organisation (currently 30). Although the data are standardised according to the OECD's guidelines, they inevitably reflect national variation in methods of variable measurement, data collection and reporting. The data have been the subject of intensive econometric analysis of the determinants of health care expenditures using cross-sectional, pooled cross-sectional and time-series perspectives. As a medium of analysis the database is very user-friendly and provides a single point of access for data on developed market economies. Nevertheless, the national variations in variable measurements, data collection and reporting result in analyses offering little cross-country comparability, which, in turn compromises the usefulness of such analyses from a policy perspective.

2.3.2 General observations from the empirical literature

The range of empirical models used to analyse the determinants of health expenditures in both developed and developing countries has been quite diverse. While the early literature focused on the simple relationship between national income and health spending, subsequent research attempted a more in-depth analysis of the determinants of health expenditures by incorporating additional variables, such as demographic factors (e.g. male or female life expectancy, infant mortality, the share of population aged 65 and over, the share of population aged 16 or under), lifestyle variables (such as the consumption of alcohol or tobacco), and variables related to the organisation and financing of the health system (e.g. financing method, provider payment methods, cost-sharing, etc).

A variety of different analytic frameworks was used including cross-sectional, time-series and pooled cross-sectional analysis. Much consideration has also been given to the appropriateness of the technique(s) used. As cross-sectional (and, subsequently, pooled cross-sectional) analysis dominated the empirical literature, one of the most important issues was the use of a conversion method, whereby financial variables from each country were expressed in a common currency. The debate here focused on the use of exchange rates, purchasing power parities (PPPs) and average wage earning power.

Regardless of the methodology, the key results remain the same over time, namely that variations in national income, as proxied by GDP, explain much of the variation in health care expenditures. Furthermore, the majority of the empirical studies have concluded that health care spending rises faster than national income, making health care a luxury good. Although this result appears to be broadly consistent over time and independent of the statistical method used, there are occasional "discrepancies" dependent on the functional form and/or the conversion method used. Thus, depending on the type of model, and whether exchange rates or purchasing power parities (PPPs) are used as conversion factors, the result is not always greater-than-unity income elasticity of demand. Table 2.1 provides a descriptive account of published literature, the type of model used and econometric analysis performed, and the corresponding income elasticity found. These results are reviewed in more depth in the following sections.

Table 2-1 Estimates of Income Elasticities of Health Care Expenditures

Author(s) and year	**Type of model (form)**	**Type of data**	**Income Elasticity**
Univariate approach			
Abel Smith (1967)	Linear	Cross-section	Luxury: 1.3
Kleiman (1974)	Log-linear	Cross-section	Luxury: 1.2
Newhouse (1977)	Linear	Cross-section	Luxury: 1.31 Luxury: 1.26
Cullis and West (1979)	Linear	Cross-section	Luxury
Maxwell (1981)	Linear	Cross-section	Luxury: 1.4
Parkin et al. (1987)	Exchange rate conversions Linear Semi-log Exponential Double-log PPP conversions Linear Semi-log Exponential Double-log	Cross-section	Luxury: 1.12 Normal: 0.8 Luxury: 1.57 Luxury: 1.19 Normal: 0.9 Normal: 0.8 Luxury: 1.12 Luxury: 1.00
Culyer (1988, 1989)	Log-linear	Pooled cross-section	Luxury
Schieber (1990)	Log-linear	Pooled cross-section	Luxury: 1.2
Gertler & van der Gaag (1990)	Log-linear	Cross-section	Luxury: 1.3
Gerdtham and Jönsson (1991)	Double-log Exchange rate conversions GDP PPP conversions Health PPP conversions	Cross-section	Luxury: 1.24 Luxury: 1.43 Luxury: 1.43
Milne & Molana (1991)	Log	Cross-section	Luxury: 1.74
Getzen & Poullier (1991)	Log-linear	Pooled cross-section	Luxury: 1.51
Getzen & Poullier (1992)	Log-linear	Pooled cross-section	Luxury: 1.4
Murthy (1992)	Double-log (corrected for heteroscedasticity) Exchange rate conversions GDP PPP conversions Health PPP conversions	Cross-section	Luxury: 1.34 Luxury: 1.57 Luxury: 1.19
Multivariate approach			
Leu (1986)	Log-Linear Model 1 Model 2	Cross-section Cross-section Cross-section	Luxury: 1.18 Luxury: 1.36 Luxury: 1.21

	Model 3		
Gerdtham, Soegaard, Anderson & Jonsson (1992)	Double log Model 1 Model 2 Model 3	 Cross-section Cross-section Cross-section	 Luxury: 1.44 Luxury: 1.296 Luxury: 1.327
Gerdtham (1992)	Log-linear	Pooled cross section	Necessity: 0.74
Hitiris and Posnett (1992)	Linear & log-linear Exchange rate conversions GDP PPP conversions	Pooled	 Luxury: 1.026 Luxury: 1.16
Viscusi (1994)	Log-linear Exchange rate conversion PPP conversion	Pooled	 Luxury: 1.1 Luxury: 1.1
Gerdtham et al. (1992b)	Double-log	Pooled	Luxury
Gerdtham et al (1994, 1995, 1998)	Log-linear	Pooled	Necessity: 0.66-0.82
Saez & Murillo (1994)	Double-log	Time-series by country	Necessity: 0.72-0.82[1] Luxury: 1.042-1.869[2]
Barros (1998)	Quadratic	Pooled	Necessity but not significantly different than 0
Roberts (1998)	Log-linear	Pooled	Around 1 or significantly higher than 1 depending on model
Murillo et al. (1993)	OLS, ML, Cointegration	Time-series	Luxury
Grubaugh and Santerre (1994)	Double-log	Pooled	Necessity: 0.7
Hansen and King (1996)	OLS, Co-integration	Time-series	No long-run relationship between HCE and GDP
Gerdtham et al. (1995)	Double-log	Pooled	Necessity
Blomqvist and Carter (1997)	Log-linear, Co-integration	Cross-section Time-series Pooled	Luxury Around 1 Necessity
McCoskey and Selden (1998)	Panel Unit Root Tests using the IPS tests	Pooled	There is a long-run relationship between HCE and GDP.

Hitiris (1997)	Log-linear	Pooled	Luxury: 1-1.2
Kanavos and Yfantopoulos (1999)	Double-log	Time-series, country-by-country analysis	Necessity for individual countries

Notes: 1 for the Netherlands (0.82) and the UK (0.72).
2 For Germany (1.052), Belgium (1.042), Denmark (1.223), Spain (1.869), France (1.235), Ireland (1.431), Italy (1.517), and Luxembourg (1.773).

Source: Author's compilation from the literature.

2.4 The relationship between National Income and Health Expenditure

2.4.1 The issues

Three important distinctions among the studies are emphasized in the following discussion, which account at least partly for the diversity of results obtained. The diversity relates largely to the value of income elasticity of demand. Although an elasticity greater than unity is commonly found, as noted above, lower-than-unity income elasticity has also been found on several occasions.

The first distinction pertains to whether the studies used:

- cross-sectional data,
- time-series data,
- pooled data over time but excluding the effects of time and country dummies, or
- pooled data over time and accounting for time and group dummies.

The second distinction is whether they used the single variable approach, where health care expenditures (HCE) are regressed on only gross domestic product (GDP), or the multivariate approach where non-income regressors are also included. The third distinction is the method used to convert the data in national currencies for the purpose of international comparison and the fourth distinction relates to the use of different functional forms of the model (linear, log-linear, double-log, quadratic, etc).

2.4.2 The bi-variate approach: evidence on the statistical relationship between health care expenditures and income

The earliest studies used the single regressor approach, thereby investigating only the statistical relationship between health care expenditure and income, whereas subsequent studies used the multivariate approach and more sophisticated econometric techniques. Given the accepted wisdom that health expenditures are affected by national income, studies in the 1960s, 1970s, and many in the 1980s used the single-variable model, thus examining the aggregate relationship between income and health care spending in a group of countries using a cross-sectional approach. Variables such as the age structure of the population, the financing of the health care system, the method of reimbursing providers, the prices of health inputs, and other aspects of health care delivery were assumed to have little importance. These first generation studies adopted an aggregate macroeconomic approach, which appears to have been based on Wagner's Law (1883), which states that as national income increases, government spending also increases mainly due to an increase in demand for public services. More specifically, the above relationship examined could be formalized as:

$$G/Y = f\,(Y/N) \qquad (1)$$

where G, represents government spending, Y represents total national income, G/Y represents government spending as a proportion of total national income, N represents population size, and Y/N represents income per capita, respectively.

One important finding of earlier empirical studies is that the health care/GDP ratio increases as the country advances to higher stages of industrialisation and standards of living. The early literature in the area dates as far back as 1963, to the pioneering work of Abel-Smith for the World Health Organisation [6]. Abel-Smith examined the following relationship for 15 countries:

Total Health Expenditure/Income = f (per capita income) (2)

In these studies it was shown that, after adjustment for inflation, exchange rates and controlling for population, GDP is a major determinant of health expenditures.

The stream of literature that followed this observation focused on whether health expenditure rises faster than GDP, by examining the statistical relationship between GDP per capita and health care expenditure per capita (bivariate regression). Following Abel-Smith's two studies, a third study using cross-sectional regression analysis to explore the same issues was conducted by Kleiman (1974). Applied regression analysis was employed with a log-linear model and the income elasticity of demand was found to be greater than unity.

Newhouse (1977) regressed annual per capita income (GDP) data on per capita medical care expenditure from 13 developed countries, working in US$ at annual average exchange rates, although the year selected was not the same for each country, varying between 1968 and 1972. The model used was linear, examining the relationship between health expenditure per capita (dependent variable) and GDP per capita (independent variable).

6 This drew on Abel-Smith's earlier work for the Royal Commission looking at future trends in health care expenditures in the UK.

$$HE_i = -60 + 0.079GDP_i, \qquad R^2 = 0.92 \qquad (3)$$

While the Newhouse study had no theoretical foundation and merely examined the relationship between two macroeconomic variables, the conclusions reached (health care having an income elasticity of demand greater than unity and per capita income explaining most of the variation in health spending [in fact 92% of it – see equation (2) above]), had considerable implications on two counts. Firstly, all factors other than income were considered to have negligible impact and secondly, because health care was found to be a luxury good, it was argued that a marginal unit of health care would contribute more towards care (or subjective components of health) rather than cure (physiological health). The latter result is "… consistent with the view that in the developed countries, medical care services at the margin have less to do with common measures of health status, such as mortality and morbidity and more to do with services that are easily measured such as relief of anxiety, somewhat more accurate diagnosis and heroic measures near the end of life …" (Newhouse, 1977, p. 123). This is a fascinating issue, given that we now include humanity within quality of care and recognise that poor quality care may deter access by those in need. Although the explanation offered was rather intuitive, it did not really emerge as a clear-cut result from the analysis performed. Following Newhouse, Cullis and West (1979) applied regression to cross-sectional data, using a linear model, supporting the luxury good hypothesis. Indeed, the authors concluded that "empirical evidence indicates health care to be a luxury good that at the margin may contribute little to physiological health, for developed countries at least".

Secondly, the higher-than-unity income elasticities of demand, based as they were on microeconomic theory, were in conflict with earlier and later studies using microeconomic[7]

7 Household or personal level.

or intermediate [8] data. In these studies the income elasticities had generally been low, and almost always less than unity (Andersen & Benham, 1970; Grossman, 1972; Newhouse & Phelps, 1974; Muurinen, 1982; Okunade, 1985; Wagstaff, 1986; Manning et al, 1987; and Gbsemete & Gerdtham, 1992). The same applies to studies that have used state or province-level data from the USA or Canada. Studies of this type include, among others: (a) Feldstein (1971), who examines income and hospital expenditure from 47 US states between 1958 and 1967 and finds an income elasticity of demand of 0.5; (b) Fuchs and Kramer (1972), examining income and physician expenditure from 33 US states for 1966 finding an elasticity of 0.9; (c) Levit (1982), examining the relationship between income and total health expenditure in 50 states between 1966 and 1978, finding an elasticity of 0.9; (d) Baker (1997), who looked at the relationship between income and Medicare health care expenditure in 3,073 US counties over the period 1986-1990 finding an elasticity of 0.8; and (e) Di Matteo and Di Matteo (1998), who examined the income-health expenditure relationship in 10 Canadian provinces over the period 1965-1991 finding an income elasticity of demand of 0.8. The reasons for this macro-economic versus micro-economic discrepancy are examined in section 2.7 below.

The model estimated by Newhouse (1977) is an over-simplified model, employing macroeconomic data to arrive at microeconomic conclusions. The main finding has, nevertheless, been confirmed in a number of other studies, such as Schieber (1990), Gertler & van der Gaag (1990), Getzen & Poullier (1991) and (1992) and Milne & Molana (1991). All these studies use the same broad approach, testing the health-GDP relationship at aggregate level.

8 Regional, implying state-level or provincial data, rather than national.

Newhouse's model has, however, been subject to several criticisms. One is that it mis-specifies the model by omitting variables and adopting an inadequate functional form (Parkin et al 1987). An additional line of criticism relates to the use of exchange rates as conversion factors. Parkin et al (1987) replicated Newhouse's regression, for 18 OECD countries, using 1980 data and experimenting with different functional forms (linear, semi-log, double-log, exponential) and using different conversion factors (exchange rates and purchasing power parities - PPPs). They found the model was sensitive to the choice of functional form, since different models yielded elasticities greater or smaller than unity (see table 2.1, column 4). It was observed, nevertheless, that semi-log models consistently imply that health care is a necessity, whether PPPs or exchange rate conversions are used, and, similarly, the exponential form results always imply that it is a luxury. It appears, therefore, that the results obtained are self-fulfilling prophecies, as in the conventional Engel curve literature such forms are deliberately used as being the most appropriate for goods which are a priori believed to be luxuries or necessities. The second finding was that the choice of conversion factor also resulted in considerable differences in the size of the income elasticity of demand. In all functional forms, PPPs would render lower value elasticities, and where the central estimate of the elasticity was above unity, it was not significantly higher than one (Parkin et al, 1987, p. 118).

A number of other studies followed which broadly confirmed Abel-Smith's (1963, 1967) and Newhouse's (1977) initial results, among them, Maxwell (1981), Gerdtham et al (1988), Culyer (1988, 1989), Cullis and West (1979), Gerdtham and Jönsson (1991a), and Parkin et al. (1987). These studies differed in incorporating additional independent variables, other than GDP per capita. Some also addressed several of the points made by Parkin et al.

Using GDP-PPP conversions, Culyer (1988, 1989) estimated individual country and pooled cross-sectional and time-series models respectively for OECD countries using 1985 OECD data. He found a strong positive relationship between health care expenditures and GDP over time. Gerdtham and Jönsson (1991a) used a cross-section from the 1985 OECD data, and cast doubt on the robustness of the results obtained by Parkin et al. They obtained an income elasticity of 1.43 even when they deflated the per capita health care spending by a Health-specific PPP index, rather than benchmark PPP index based on the general basket of goods and services (GDP-specific PPP). The significance of using a Health-specific PPP index is that, at least in theory, it is specific to variations in the prices included in a basket of health-related goods and services, whereas a GDP-specific PPP index is a much more general measure of variations in prices of all goods and services included in the index, which also includes health goods and services, but which only make up a very small proportion of the total. All PPP indices, whether Health-specific or GDP-specific are constructed on the basis of a basket of goods and services which is "representative" of household consumption in each country and broadly comparable across countries[9].

Some studies used the linear form, some the log-linear and others the double-log specification of the expenditure equation. When different functional forms and/or estimation techniques were used on the same data, the results changed (see Parkin et al., 1987). ,. The preference for the log-linear form over the linear form is "based on the contention that the linear model biases the health-expenditure to GDP elasticity towards luxury good values, particularly if inflation has a disproportionate impact on health expenditure (Hitiris 1997, p. 4)." A logarithmic function stabilizes data and the relationship between variables and is therefore considered to be optimal for analytical purposes. Gedtham and Jönsson (1991) replicated the

9 Despite the arguments about a Health-PPP index being representative, we show in chapter 3 that this is far from being the case. This also shows a further inherent problem in empirical research of this kind: the fact that

simple one variable approach used by earlier studies with updated data, using a cross-section of 22 OECD countries in 1985. They estimated the double-log form and found the health care income elasticity to be greater than 1 regardless of whether exchange rates, Health-specific PPPs, or GDP-specific PPPs are used for monetary conversions. They used an established functional transformation (a Box-Cox transformation, Box & Cox (1964)) to decide upon the most suitable functional form to use, and concluded that the double-log function relating health care expenditure and GDP was "the most adequate in cross-sectional comparisons of health care expenditure (Gerdtham and Jönsson, 1991, p. 230)", therefore yielding the best fit.

The above studies consistently found income elasticities of demand for health care that are greater than 1, suggesting that health is a luxury good. Table 2.1 summarises the results. Given that about 90% of the variance in medical care expenditures across countries was found to be explained by income, the authors concluded that factors other than income are not likely to be important determinants of a country's health care expenditures.

Parkin et al (1987) used different functional forms and different conversion factors to comment on results obtained by other authors. This enabled them to comment on several issues including the cost of inputs versus volume of services, the type of analysis, and the assumptions made, as well as providing a response to Newhouse's comment on the caring/curing dichotomy. First, they confirm the strong positive relationship between GDP per capita and health care expenditure per capita defined using Purchasing Power Parities (PPPs). Second, they show that the percentage of health care spending in GDP and per capita GDP itself are weakly associated, when the former is defined by GDP-PPPs. Third, they

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there is an over-reliance on what is readily provided, without much scrutiny on the methodology used.

show that expenditure on medical care is more responsive to GDP per capita than are various measures of staffing (numbers of doctors, nurses). Fourth, they argue that, because staff levels vary less than expenditure, much of the variation is in price per unit, supporting the use of Health-specific PPPs. As well as identifying certain model misspecifications in previous research, they also show that income elasticity can vary according to the type of deflator used. Thus, an income elasticity of 1.18 is calculated when the deflator is the exchange rate, whereas it drops to 0.9 when the Purchasing Power Parity (PPP) is used as a deflator. Finally, they also question what then was an accepted view that the additional expenditure is buying "caring" rather than "curing".

Newhouse (1987) criticises the approach taken by Parkin et al (1987) and questions their conclusion that variations in health care expenditure reflect primarily variation in factor prices on the grounds that staffing ratios do not strongly respond to income; instead he argues that if one used hedonic (i.e. quality adjusted) prices, US staffing ratios would probably vary more strongly with expenditure. In defending the "care rather than cure" conclusion, he argues that significant literature supports this earlier finding. Finally, he seems to place more value on the finding that income elasticities from international cross-sectional comparisons substantially exceed zero, rather than the income elasticity exceeding unity. This appears to be a departure from the earlier stance that income elasticity of demand is definitely greater than unity. Finally, Milne and Molana (1991) have experimented with the impact of prices on the robustness of the income elasticity of demand and find that for the OECD countries health care can be described as a luxury good, although the income effect is absolutely compensated by variations in prices. Milne and Molana reject Newhouse's (1977) estimates and point out that Parkin et al's (1987) results correspond to an excessively restricted model.

There are several drawbacks associated with these studies. Most of them utilized cross-sectional data drawn from a single year because data were not available that spanned multiple years. Of the studies listed above, only a few used pooled data over time. Among them were Culyer (1988, 1989), Schieber (1990), and Getzen and Poullier (1991, 1992). The data sets were very small, the econometric models were not equipped to control for individual country differences that may cause variations in health care expenditures, and comparable data across countries were not readily available. According to Parkin et al. (1987), "all income elasticities from single-variable equations are unreliable (p.120)." In addition, the absence of variables other than income may have led to specification bias from omitted variables and caused large income elasticities.

As already noted, when comparing results over time and among countries at the same time, adjustments are necessary to make monetary variables as comparable as is possible. Most of these studies converted financial data using exchange rates. Parkin et al. (1987) showed that the results differ significantly when different criteria are employed. They used a cross-section of 18 countries published by the OECD in 1985 and regressed health care expenditure per capita on GDP per capita for 1980 and health expenditures as a percentage of GDP per capita. They first used exchange rate conversions into the U.S. dollar, and then they used the purchasing power parities (PPPs) index for health care published by the OECD. The results obtained when using exchange rate conversions were consistent with results from other single-variable studies. Namely, they found that the income variable accounts for a large proportion of the variation in health care expenditure. The income elasticity at the mean was also found to be greater than one. On the other hand, when PPPs were used, the income elasticity dropped to 0.90, implying that health care is a necessity good. Parkin et al. (1987)

concluded that "international comparisons of commodities which are based upon exchange rates are at best approximations (p. 113)."

Similar results were obtained in additional pieces of research that used pooled cross-sectional data from several OECD countries and for a number of years (Gerdtham, 1991). A number of studies in the 1980s and 1990s incorporated the work of Grossman (1972) who provided the theoretical framework for the microeconomic approach in his theory of consumer utility maximization and demand analysis. As a result, the use of pooled time-series data became more frequent but was not without problems as the following sections suggest.

2.4.3 Conversion factor instability: Exchange Rates and PPPs for the Comparison of Health Care Expenditure across Countries

When performing cross-sectional or pooled cross-sectional analysis across countries, health care expenditures and GDP have been converted into a common currency either through market exchange rates, or through the use of purchasing power parities (PPPs) [10]. The debate here focuses on which of these two methodologies is more suitable for comparative analysis and generates more robust results. In this context, Parkin et al (1987), and Gerdtham & Joensson (1991a, 1991b), have drawn attention to the importance of the conversion factor used to enable comparisons to be made between expenditures denominated in national currencies.

Parkin et al (1987) have argued against the use of exchange rates as deployed by several earlier authors (Kleiman, 1974; Newhouse, 1977; Cullis & West, 1979; Maxwell, 1981; and Leu, 1986), on the basis that they may not adequately reflect relative purchasing power across

10 These can be either GDP-based PPPs, or health-related PPPs.

countries and that their use attaches little weight to non-marketed commodities such as health care. In that context, Purchasing Power Parities (PPPs) have been used, which are thought to reflect purchasing power across countries and also enable differentiation between health and GDP parities (Health-PPPs and GDP-PPPs, respectively). In particular, the use of Health-PPPs for health care expenditures is crucial in that, if the relative price of health care increases with per capita income, this will lead to an overestimation of the pure health care income elasticity as assessed by simple exchange rate conversion or with GDP-specific PPPs. There is also a stream of literature from international trade theory proposing good arguments for a relationship between the relative price of health care and per capita income (Kravis et al, 1982; Bhagwati, 1984; Kravis et al, 1988). On the basis of a sample of 18 OECD countries in 1980, the use of different conversion factors, i.e. exchange rates and Health-specific & GDP-specific PPPs, yields different estimates of income elasticity of demand for health (see Table **2.1**). This stream of literature concludes that although GDP-specific PPPs offer significant conceptual advantages over exchange rates, neither is a theoretically correct conversion factor in that context. However, the question of suitability of GDP-specific versus Health-specific PPPs is not addressed.

On the other hand, Gerdtham & Jönsson (1991) reported results for a similar sample of 22 OECD countries using 1985 data, testing the same relationship between health expenditure and income by using a linear multiplicative functional form. They suggested that the value of the estimated income elasticity is invariant with respect to the use of GDP-PPPs or Health-PPPs, while the use of exchange rate adjustment leads to a slight fall in the estimated elasticity, but remains well above unity. Thus, Gerdtham & Jönsson (1991) found no perceptible conversion factor instability (using exchange rates, GDP-specific PPPs, and

Health-specific PPPs to convert per capita health care expenditure) with respect to the magnitude of the health care income elasticity.

Murthy (1992) pointed out that Gedtham & Jönsson's (1991) results reported above might be biased due to heteroscedasticity [11] in the residuals. He re-estimated Gerdtham & Jönsson's models with exactly the same data and corrected for heteroscedasticity, by employing the White heteroscedasticity consistent covariance matrix estimator (White, 1980). Contrary to the finding by Gerdtham & Jönsson (1991), the income elasticity presented by Murthy was not significantly greater than unity in the case of per capita health care expenditure deflated by Health-specific PPPs (see table 2.1). This finding suggests that health care is perhaps a necessity rather than a luxury. Thus, the income elasticity is not identical for the two PPP conversion factors. This elasticity measure is sensitive to whether exchange rates or PPPs are chosen. In a nutshell, it appears that Murthy confirms Parkin et al's (1987) finding of conversion factor instability, using a larger sample and a different year.

However Gerdtham & Jönsson (1992), in a response to Murthy (1992) apply further tests for heteroscedasticity, but cannot detect it, which leads them to conclude that the income elasticities of demand exceed unity with all conversions and that these results are robust as estimated (see table 2.1). They also confirm another point raised by Murthy, namely the existence of outliers in the sample, and the fact that they influence the regression results. It is concluded that it is important to examine for sensitivity to changes in the sample or the estimation procedure [12].

11 Heteroscedasticity in a model arises when the variance of the disturbance factor may not be constant for all observations in a cross-section model. In this case, the conventionally calculated *t*-statistics of the regression coefficients may be overstated.

Kravis et al (1978) pointed to the greater ability of PPP compared with exchange rates to evaluate the true volume of health care expenditure and income. Milne & Molana (1991), in support of Parkin et al (1987), argued that when prices are allowed to play an unrestricted explanatory role, the income elasticity turns out to be significantly greater than unity for health care expenditures. They found that for OECD countries health can be described as a luxury good although the income effect is absolutely compensated by variations in prices. However, as Karatzas (1992) argued, this conclusion is questionable and that the empirical evidence is not uniformly supportive. He found a real income elasticity for health expenditures which is smaller than unity. It also emerged from his findings that the use of exchange rates, instead of PPPs, resulted in a smaller-than-unity income elasticity for real health expenditures during the sample period.

It emerges, therefore, that there is considerable uncertainty in the literature as to which conversion method (exchange rate, Health-specific PPPs, GDP-specific PPPs) yields robust results, and whether these results are reliable across countries and over time. It is important to note that all the empirical literature summarised so far tested the simple relationship between health care expenditures (per capita) and GDP (per capita), without the inclusion of other explanatory variables on the right hand side of the models.

All these studies also use cross-sectional or pooled cross-sectional data. Murillo et al (1993) and Saez et al (1994) used times series data by country and continued the tradition of GDP-specific and Health-specific PPPs, by converting aggregate health expenditure and GDP figures from national currencies into a common denominator by using Health- and GDP-PPPs, respectively. They correctly point out that health spending and income per capita may

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12 The authors do that by using other estimators when outliers are present in order to show the sensitivity of results to sample changes or estimation procedure changes.

not be stationary and, hence, may be subject to underlying trends that would affect the nature of the results obtained with linear regression analysis. By using dynamic econometric modelling, they concluded that GDP PPPs can be taken as a universal price index that can be applied to convert both GDP and Health data. They also found a greater-than-unity income elasticity of demand.

2.4.4 Final remarks on the bi-variate approach

The empirical evidence summarised in the previous sections spans over 30 years and comprises a gamut of investigations ranging from simple observations on the relationship between health care expenditures and income to sophisticated econometric analysis. The following remarks can be made at this stage:

First, the vast majority of the surveyed literature does not take into account the fact that health care expenditure is an element of GDP. This may have an impact on the validity of the obtained results, regardless of whether a cross-sectional, pooled cross-sectional or time-series approach is used. This may offer an explanation as to why researchers using the same data sources and statistical analysis (cross-sectional or pooled cross-sectional), but for different years, arrive at different, and, often opposing, results.

Second, if time series analysis is employed, there is a strong probability that the data from most countries will have underlying trends, a phenomenon common across macroeconomic time-series, which leads to biased model estimates which offer no explanatory validity. Robust analysis should de-trend the data in order for regression estimates to have of any value or policy relevance.

Third, it appears that a great deal of effort has been expended on determining the best conversion factor for cross-country comparisons. This is a key point, since it relates to a great extent to the perception of health care as a non-tradable "good", the price of that service relative to the aggregate price level in the economy, and the volume of health services produced. There appears to be some consensus in favour of using PPPs instead of exchange rates, although research seems to suggest that because of the nature of health care, Health-PPPs ought to be used to deflate health care expenditures, and GDP-PPPs to deflate income, rather than using GDP-PPPs for both health expenditure and income variables.

2.5 The multivariate approach

The multi-variate approach to the investigation of the determinants of health care expenditures recognises that the bi-variate approach is problematic due to omitted variables and the bias in the income coefficient that results. Several studies have tried to address the determinants of health care expenditure in a more comprehensive and robust way. Cross-sectional, pooled cross-sectional and time-series analyses have been employed. This section summarises the evidence from all three statistical approaches.

2.5.1 Multivariate cross-section analysis

2.5.1.1 Empirical evidence

Leu (1986), using cross-section data from 19 OECD countries (excluding Luxembourg, Iceland, Japan, Portugal and Turkey), tested for significance of variables other than per capita income. His model included institutional factors and factors related to health outputs. Other variables in his analysis included, first, exogenous variables, such as the proportion of persons under 15 and over 65 (to test the hypothesis that the young and the old tend to use more health care than others), and urbanisation (to test the hypotheses that the risk of contagion is higher and time and travel costs are lower in cities); second, a variable to reflect the extent of public sector provision of health services, to test the hypothesis that an increase in the size of public share would increase total spending. This makes use of well-known results in public choice theory. Leu also suggested that health expenditures should increase as the fraction of health expenditure that is public increases, assuming implicitly that this fraction reduces the price to consumers. Finally, he used a number of dummy variables to capture features dominant in individual health care systems, for instance a dummy for the National Health Service in the UK and New Zealand, where centralised budget control might have a restraining effect, and a dummy for direct democracy in Switzerland, on the grounds that controlling health care expenditure might be easier if voters had greater direct control over government choice and tax levels.

It was found that income provided an explanation for most of the variation in health care spending, with an elasticity of demand exceeding unity (See table 2.1). Additionally, a statistically significant relationship was found between health care expenditure and demographic as well as health system-related variables (e.g. population under 15 years, urbanisation, the ratio of public financing to total financing, the ratio of public beds to total beds). The signs of the parameters were also found to be as expected, although with mostly small coefficients. The strongest results were: (a) a 10% increase in the public to total bed ratio would increase health care expenditure by 8-9%, and (b) the NHS dummy suggested that an NHS-type system would lower health care expenditure by 20-25%, ceteris paribus.

Leu's analysis has remained controversial, particularly as regards the institutional variables. Indeed, Culyer (1988) noted that private sector bureaucrats are not necessarily better controlled than their colleagues in the public sector that costs in the private sector may be larger due to advertising and selling costs and that market pressures may be less reliable than professional ethics and regulation. Culyer (1989) also suggests that both of Leu's hypotheses, i.e. that both public finance and public provision increase expenditure, depend on a passive response from the financing agent, who adjusts the supply of finance to the quantities and prices of health care services. It is further suggested that the financing mechanism, in particular, the degree of open-endedness of finance and the lack of budget restriction, would be more relevant than the distribution of finance and provision between public and private institutions. The conclusion of this discourse appears to be that the impact of the fraction of finance and/or provision that is public on health care expenditure cannot be determined *a priori*. However, countries with more closed health care financing systems are anticipated to have lower expenditure. Despite the reference made to public choice theory, the *a priori* signs of the variables proposed by Leu remain in doubt and other investigators, have not been able to replicate these results. This may be partly due to the fact that the year or the period of analysis typically changes amongst investigators as does the functional form used in the analysis (e.g. linear, log-linear, double log). The combination of the two may produce different results altogether.

Gerdtham et al (1992a) performed a cross-sectional analysis of nineteen OECD countries, using data from 1987, and estimated a double log linear model as follows:

$$\begin{aligned}\mathbf{LnHCEpc} = \mathbf{ln\ b_1 + b_2lnGDPpc + b_3lnRPhc + b_4lnDOCpc + b_5lnIP} +\\ \mathbf{b_6lnPF + b_7FEE + B_8GLOBAL + b_9lnFP + b_{10}lnAGE} +\\ \mathbf{b_{11}lnURB + e} \qquad \mathbf{(4)}\end{aligned}$$

The model included GDP per capita (GDPpc), variables representing socio-demographic conditions (age structure of population (AGE) and urbanisation [(RB)], institutional factors such as the share of total health expenditures used in inpatient health care (IP), preponderance of fee-for-service in outpatient care (FEE), share of public health finance (PF), number of practicing physicians per capita (DOCpc), a female participation ratio (FP) (measured as labour force/population aged 15 to 64 years), and a dummy variable capturing other institutional variables, such as global budgeting in hospital care (GLOBAL).

2.5.1.2 The results of the multi-variate cross-section analysis

All three models found a greater-than-unity elasticity (see table 2.1). The authors' "preferred" model had five variables: GDP per capita, urbanisation, fraction of public financing, fraction of in-patient care expenditure, and the dummy variable for countries with fee-for-service payment. This accounted for 95% of the variance and nearly all variables had the expected sign. In contrast to Leu, an increase in the fraction of public financing by 10% was associated with 5% lower health expenditure, while a 10% increase in the fraction of in-patient care had a positive impact on health expenditure of around 2%. Thus, it was argued that a greater degree of public penetration offers a better opportunity for the control of health care expenditure, as the two variables were negatively related. The fee-for-service dummy variable indicated that health expenditure was about 11% higher than in countries where that arrangement dominated, thus confirming what was believed to be the case. None of the demographic variables except urbanisation was significant and this had an unexpected (negative) sign.

2.5.2 Multivariate pooled cross-section analysis

Pooled cross-sectional analysis enables the testing of country and time-invariant effects and the larger number of observations is advantageous statistically. A number of studies have employed pooled cross-sectional analysis and this tool has, over time, enabled the testing of diverse models with a large number of regressors and the use of several dummy variables in a single model.

Gerdtham (1992) used data for 22 OECD countries for the period 1972-1987, exploring several models with dynamic adjustment of health expenditure to movements in exogenous variables and different lag structures. A reduced number of explanatory variables were specified: GDP, inflation, share of public financing, and the proportion of the elderly (over 65 years of age) in the population. Static as well as restricted error correction models were specified and tests were carried out using five different panel data models, i.e. two-way country and period fixed and random effects models, one-way fixed and random country effects models, and strict ordinary least squares (OLS) without country and time dummies. An important conclusion was that country or time-specific effects had important implications for the results. Indeed, permanent non-identified country and time-period effects were found to influence health expenditures and had a significant impact on the income elasticity of demand. An important finding was that the estimated elasticity of health expenditure with respect to GDP was 0.74 (significantly lower than unity), in static equilibrium models and using both country- and time-period dummies), but the remaining variables were insignificant.

Hitiris & Posnett (1992) re-estimated the models of Newhouse (1977) and Leu (1986), using a sample of 560 pooled time-series and cross-sectional observations from 20 OECD countries for the 1960-1987 period using an OLS estimation. All models were estimated both in linear and log-linear form. Their estimation method took into account cross-sectionally heteroskedastic and time-wise autoregressive disturbance terms [13] and the degree of autoregression varied among cross-sections. The model that was used was

HCE (real per capita health care expenditures) =
= f (GDP, real per capita gross domestic product;
POP65, the proportion of the population over the age of 65;
PUBL, the proportion of HCE that is publicly funded) (5)

The results obtained confirmed the importance of GDP as a major determinant of health expenditure, with an estimated income elasticity of at or around unity (1.026 with an exchange rate conversion and 1.16 with a PPP conversion; see table 2.1). The importance of some non-income variables is also confirmed, although the direct effect of these factors appears to be small. In particular, the share of population over 65 and the share of public health expenditure were found to be statistically significant. The authors also suggest that since the relative price of health care [14] is related to the structure of the national system of health finance and delivery, such factors may also enter indirectly as determinants of health spending. However, evidence from cross-sectional studies suggests that the effect of relative price on health expenditures is not significant (Gerdtham & Jönsson, 1991b; Milne & Molana, 1991).

Viscusi (1994) explored the impact of health promotion on mortality. The working hypothesis employed was that health promoting policies intended to reduce mortality might in fact increase it as the resources it consumes leads to a reduction in citizens' disposable income, which, in turn, increases the risk of mortality. This implies that it is important to estimate the marginal expenditure per statistical life lost. Viscusi proceeds from the following

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13 A significant problem in time-series econometric analysis is autocorrelation in the residuals (the disturbance term), a flaw that leads to biased parameter estimates, whose explanatory power is, in turn, very poor. Estimation methods exist that correct for this problem and this is one of the approaches used.

14 Assuming that PPPs are used for the conversion of prices, the relative price of health care can be defined as

relationship between the expenditure that will generate the loss of a statistical life and the marginal value of life:

Marginal expenditure per statistical life lost = Marginal value of life/Marginal propensity to spend on health (6)

One approach to estimating the marginal expenditure per statistical life lost is, first, to estimate the marginal propensity to consume health care out of income, using OECD data, and then to use this figure as a denominator in equation (6) above, in conjunction with a value-of-life in the range of $3-$7 million. In the estimation of the marginal propensity to spend, Viscusi used panel data for 24 OECD countries for the years 1960-1989 and a log-linear weighted least squares model of health expenditures, including GDP and unemployment rates, with and without 29 year dummies and 23 country dummies (two-way fixed-effects models). Health expenditures and GDP were converted using both exchange rates and Health- and GDP-PPPs. In accordance with previous studies the results showed that GDP alone had a very high explanatory power, and that the unemployment rate was an insignificant factor. The estimated income elasticity of demand in the two-ways fixed-effects models was about 1.1 (see table 2.1) irrespective of whether health expenditures and GDP were converted into a common denominator by exchange rates or PPPs [15].

One further study by Gerdtham and Jönsson, published in three different locations (1994), (1995) and (1998), employs pooled cross section analysis for 22 countries, over the 1970-1991 period examining the effects of different types of institutional arrangements (a series of

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(Health PPP/ GDP PPP).

dummies attempting to capture organisational factors, such as share of public beds, share of co-payments, renal dialysis per million population, doctors per 1000 population, fee-for-service reimbursement of doctors, and dummies related to the type of health system in place, whether integrated, or public reimbursement, among others), and non-institutional factors (GDP, proportion of population over 75, proportion of population less than 5, female labour participation ratio as % of active population, unemployment rate, alcohol consumption and tobacco consumption) on health care expenditures. The findings include, among others, an income elasticity of demand below unity for models correlating total health spending with its determinants, but also for models correlating components of health expenditures (in-patient care, ambulatory care, pharmaceutical spending) with their determinants. The relationship between the various components of health spending and GDP is found to be statistically significant. It was also found that an increase in tobacco consumption by 10% would increase health expenditure by 1.3%. Tobacco consumption is considered in these studies to be a proxy for other behaviour that leads to higher health expenditure. However, no lags are considered when including the tobacco variable in the model, which is surprising given the lengthy lag period between initiating smoking and acquiring disease.

The authors also find institutional factors (methods of paying physicians, the existence or not of gate-keeping) of great importance in the determination of total health spending. The authors admit that many of the findings were unexpected, particularly those concerning the institutional dummy variables. For instance, public reimbursement systems were found to be the least expensive, with public integrated systems about as costly as public contract models of health care. This is contrary to other empirical evidence (Hurst, 1992). Furthermore, countries with budgetary ceilings on inpatient care appeared to have higher total expenditure,

15 Further from this estimation, the estimated marginal propensity to spend was around 0.1, which implies that the marginal expenditure that will lead to the loss of one statistical life ranges from $30 million to $70 million.

while larger numbers of doctors appeared to be related to lower overall expenditure. Additional confounding factors seem to be at play here, which the above research simply could not capture.

Further studies using this methodology have included work by Barros (1998), Roberts (1998), and Hitiris (1997) who have dealt with the same issues as the previous studies, but in a different way. Barros used data for 24 OECD countries and for the 1960-1990 period. Contrary to Gerdham et al (1994, 1995, 1998), he concluded that the existence of gatekeepers and the type of health system have played no significant role in containing health expenditure growth. Furthermore, aging, and the relative size of public financing have not contributed to the growth of health expenditure. The income elasticity of demand was found to be lower than but close to unity, which is in line with the result found in previous pooled cross-sectional studies. Roberts (1998) used data from 20 OECD countries over the 1960-1993 period and estimated static and dynamic models of determinants of health care expenditures, by including both institutional and non-institutional factors in her analysis. A positive and significant long-run elasticity of public financing was obtained, consistent with Leu (1986) but different from Gerdtham (1992) and Barros (1998). In accordance with Gerdtham (1992) and Barros (1998), the effect of population ageing was not significant. The relative price of health care was also not significant. The income elasticity of demand for health care was found to be around unity or significantly higher than unity, depending on the model used.

Hitiris (1997) applied pooled cross-section analysis to a sample of 10 European Union (EU) countries, arguing that " ... since health care expenditure depends primarily on the level of economic development and the structure of the population, only convergence in economic performance and the standards of living can lead to convergence of health expenditure standards ..." (Hitiris, 1997, p. 1). He estimated the following model in log-linear form:

$$\mathbf{HC_{it} = a + b_1Y_{it} + b_2P_{it} + b_3G_{it} + b_4I_{it} + b_5D_{it} + u_{it}} \qquad \mathbf{(7)}$$

where in the I-*th* country and t-*th* year, HC is per capita health expenditure, Y is per capita GDP, P is the dependency rate (population aged 0-19 plus population aged 65 and over taken as per cent of population aged 20-64), G is the share of health care expenditure in total public spending, I is the rate of inflation (1985=100), D is a country dummy variable to account for differences in countries' health service systems, and u is an error term. Hitiris pooled time-series and cross-sectional data from 10 European Community (EC) countries consisting of observations for 1960-1991, and deflated the data using the PPP conversion (both GDP- and Health-PPPs). The estimation technique used involved a double transformation of the observations to remove autoregression and time-wise heteroscedasticity before applying generalized least squares. All the main explanatory variables were found to be statistically significant, and the estimated income elasticity ranged from 1.0 to 1.2. One of the main criticisms of his analysis is that he did not take into account the literature on prices and the extent to which they differ between countries having different levels of wealth (Maxwell, 1981; Kravis et al, 1982; Kravis et al, 1988).

2.5.2.1 The key findings of pooled cross-section analysis

Pooled cross-sectional analysis has yielded interesting results over time, some of which were consistent with expectations and some not. The results obtained, both expected and unexpected, may have been due to either poor functional form or misspecification. Most of the pooled cross-sectional studies, particularly those making extensive use of dummy variables, suffer from considerable problems, which limit their ability to capture the determinants of health care expenditure and thus to contribute to policy analysis and development.

One such problem, particularly applicable in the case of fixed effects models, is that too much of the cross-sectional variation may be attributed to the dummy variables representing specific countries and/or time periods, rather than to the regressors which attempt to capture the influences of economic and institutional factors. A second problem is that various authors seem to be making assumptions about the state of health care systems in different countries, without taking into consideration break points in the data and/or the introduction of reforms that change organisational structures in different systems. Third, it is questionable whether behavioural variables, such as tobacco consumption, can be included in levels since, as noted earlier, it is known that the impact of tobacco consumption on human health involves a significant lag, the precise structure of which will vary depending on levels of exposure to other risk factors. Fourth, the interpretation of individual effects in a pooled cross-sectional analysis that makes excessive use of dummies is rather problematic. For instance, budget ceilings may be correlated with health expenditure because policy makers in different countries may respond to higher expenditure by implementing spending caps. And, finally, there appears to be a close relationship between several of the dummy variables. In this case, one variable will appear to be non-significant, even if it has contributed to a significant effect found for the related variable. This is a well-known problem in applied econometrics, called multi-co linearity, and calls for a closer examination of the size of the model in terms of robustness and parsimony.

The failure by many authors to take account of these problems is likely to explain the diversity of results obtained, with a great variation in the value of the income elasticity of demand, ranging from significantly lower than unity, to significantly higher than unity.

2.5.3 Multi-variate time-series analysis

2.5.3.1 The importance of co-integration

At a casual level, many observed time series seem to display non-stationary characteristics. For economic time-series non-stationary behaviour is often the most dominant characteristic. Some series grow in a secular way over long periods of time, and others appear to wander around as if they have no fixed population mean. Growth characteristics are especially evident in time series that represent aggregate economic behaviour, such as gross domestic product and industrial production. Random wandering behaviour is evident in many financial time series, such as interest rates and asset prices. Similar phenomena arise in data from other sectors, such as communications and political science, one example being opinion poll data on presidential popularity. In health care, macroeconomic time series, such as total health spending, or public expenditure on health care or some element thereof, such as hospitals, may also display trends making them non-stationary. The implications of trends in macroeconomic time-series are that any statistical interaction between two or more such series yields biased results and, therefore, leads to wrong (policy) conclusions. Evidently, therefore, any attempt to explain or forecast such series requires a mechanism to capture the non-stationary elements in the series, or for the series to be transformed in some way to achieve stationarity. Yet this is often difficult to achieve. The problem is particularly delicate in the multi-variate case, where several time series may have non-stationary characteristics. Testing for stationarity in macroeconomic time-series is therefore very important and should not be omitted. Where stationarity is absent, but can be achieved through a transformation of the statistical relationship, analysis requires a specific type of analysis, called co-integration analysis. Other than simply analysing the relationship between two or more variables, co-integration analysis examines their long-run relationship.

The literature on the formulation, estimation, and testing of models for potentially co-integrated economic time-series is truly vast, bordering on a complete discipline in its own right (Banerjee et al, 1993); (Hamilton, 1994); (Hendry, 1995); (Johansen, 1995); (Hansen & Johansen, 1998); Hatanaka, 1996). It is therefore important that statistical analyses investigating the relationship between macroeconomic variables may first need to test for trends in the data and integration between different variables, before embarking on econometric analysis [16].

2.5.3.2 The empirical evidence

A number of empirical studies emerged in the mid- to late-1990s using co-integration analysis. These studies used expanded data sets to study the long-run equilibrium relationships between non-stationary time-series. Many of them were devoted to a more thorough investigation of the issues of non-stationarity in the health care expenditures and GDP time-series. Some used conventional tests such as the Augmented Dickey-Fuller (ADF) test of unit roots and the Engel-Granger co integration test, but the most recent ones used dynamic modelling and panel unit root tests on health expenditure, GDP and other variables for OECD countries. In general, the results from this type of studies found health care income elasticities of less than unity, and one study found no long-run relationship between health expenditure and GDP. These studies include those by Saez and Murillo (1994), Grubaugh

16 A more detailed analysis of co-integration and the context in which it is used in this thesis can be seen in the relevant chapter on methodology.

and Santerre (1994), Hansen and King (1996), Blomqvist and Carter (1997), McCoskey and Selden (1998), Kanavos and Yfantopoulos (1999), and Getzen (2000).

Saez and Murillo (1994) use time series analysis on a country-by country basis, employing co-integration analysis to investigate the income – health expenditure relationship. Their contribution lies mainly in two areas. First, the extent to which Health-PPPs can be used and, secondly, the robustness of the results obtained in the light of omitted variables. They provide empirical evidence about the causes of discrepancies in the estimation of the actual values of income and price elasticity of health care expenditure. Their finding is that although GDP-PPPs can be taken as a universal price index, this is not the case for Health-PPPs, the problem being that the latter's components do not share common trends. Furthermore, specification errors in general and the omission of relevant explanatory variables in particular seem to be the major causes of discrepancy with the results of previous studies. They also found a strong positive relationship between income and health care expenditures, but that the elasticity is around or slightly above unity (see table 2.1).

Grubaugh and Santerre (1994) compared the relative performance of the US health care system to those of other OECD countries. Using data from Health Care Systems in Transition published by the OECD in 1990, the OECD National Accounts (various years), and the OECD Labor Force Statistics (various years), they complete a panel data set of 12 OECD countries (other than the U.S.) to estimate the following health expenditures equation for the period 1960-1987:

$$\mathbf{Y_{jt} = \alpha X_{jt} + \upsilon_{jt}} \qquad \textbf{(8)}$$

υ_{jt} = **error term**

where Y is the log of health care expenditures per capita, and X is a vector of variables representing GDP per capita, population density, real education expenditures per capita, female labour participation rate, per capita real expenditures on alcoholic beverages, per capita real expenditures on tobacco products, the percentage of the population over age 65 and under age 15, a time trend, and country-dummy variables. They found evidence of autocorrelation and therefore used the Beach-McKinnon maximum likelihood procedure adjusted for estimation of pooled cross-section and time-series data. The estimated income elasticity of demand was 0.7.

Hansen and King (1996) contended that the strong positive correlations that Culyer (1988, 1989) and Hitiris and Posnett (1992) observed between health expenditure and GDP could be the result of non-stationarity in the respective time-series. They estimated the same model as Hitiris and Posnett (1992) with the addition of the share of population under 15 years (POP15), and the relative price of health care (RELP), using the OECD 1990 data set for 20 countries for most variables covering the period 1960-1987. They tested for non-stationarity of the time-series of the variables in their model using the conventional Augmented Dickey Fuller (ADF) test and found them to be integrated of the following orders:

- health expenditure and GDP were integrated of order 1 [I(1)] or of order 2 [I(2)];
- the relative price of health care (RELP) was integrated of order 0 [I(0)] or of order 1 [I(1)]; and
- the share of population over 65 years (POP65) was integrated of order 1 [I(1)] in general.

The above results mean that if models that contain such variables as (a) health expenditure, (b) GDP, (c) the relative price of health care and (d) population, are run in levels, they yield biased estimates which have little usefulness for policy analysis because these variables are non-stationary[17].

The authors used the Engle-Granger (EG) co-integration test to test for a stationary linear relationship between the non-stationary variables and found no evidence of co-integration for 17 out of 20 countries, and could not reject the hypothesis of no co-integration for 2 other countries. Their findings suggested that there was no long-run relationship between health care expenditures and GDP, or between health expenditure, GDP and the non-income variables in their model. However, they pointed out that "the interpretation of the ADF and EG tests should be treated with some caution" and that both are "subject to important caveats (p. 123)." Namely, they stated that the "null hypothesis of non-stationarity was probably not rejected as often as it should have been (p. 133)", probably due to the smallness of the sample size which implies a low power of the Augmented Dickey Fuller test.

Blomqvist and Carter (1997) estimated the health expenditure income elasticity in the context of a long-run equilibrium relationship between non-stationary series, namely between GDP and expenditures on health care. Their examination was spurred by the desire to explain the discrepancies between the low income elasticities of health obtained from studies using individual or family data, and the high income elasticities obtained in studies using aggregate country data. They used time-series data for 18 countries over 32 years published by the OECD in 1993 to address the issues of non-stationarity and co-integration, and to find out whether pooling data is "a useful way of obtaining more precise inferences about the income elasticity, and to consider again whether the evidence suggests it exceeds one (p. 211)." Their model consisted of a log-linear relationship between per capita health care spending and real

17 I(1) means that a (time) series is stationary in first differences, but not in levels; I(2) means that a series is stationary in second differences but not in levels or first differences. Consequently, I(1) variables must be

income, and included country-specific dummy variables to account for many of the institutional and demographic variables that were omitted due to the difficulty of constructing comparable time-series for them. They analyzed cross-sections and replicated earlier results, namely income elasticities above unity. They also analyzed individual country series using conventional tests of unit roots and co-integration, and could not reject the null hypothesis of no co-integration for some countries. Then they proceeded by using the test of the null hypothesis of a unit root recently developed by Levi and Lin (1993) and found that health expenditure and GDP were integrated of order 1 [I(1)] around a linear trend. The next step was to test for co integration between the series. As others had done before, one way to do so was to employ the Engle-Granger test. But as was pointed out by Hansen and King (1996), the smallness of the samples used in the study may greatly lower the power of the Engle-Granger test. Banerjee et al. (1993) suggested that using dynamic rather than static regressions would reduce the finite sample biases of the Engle-Granger tests. Drawing upon the former suggestion, Blomqvist and Carter estimated the following dynamic regression:

$$\mathbf{h}_{it} = \phi_{0,i} + \phi_{i,1}\mathbf{y}_{i,t} + \phi_{i,2}\mathbf{y}_{i,t-1} + \phi_{i,3}\mathbf{y}_{i,t-2} + \phi_{i,4}\mathbf{h}_{i,t-1} + \phi_{i,5}\mathbf{h}_{i,t-2} \qquad \textbf{(9)}$$

(where $\mathbf{h}_{it}$ is health spending)

to obtain the residual which they used in:

$$\Delta\hat{\mathbf{e}}_t = \delta\hat{\mathbf{e}}_{t-1} + \mathbf{u}_t. \qquad \textbf{(10)}$$

The null hypothesis is that $\delta=0$ (δ being the coefficient of the lagged error term), and the t-ratios used are computed using the Phillips and Perron (1988) procedure. A failure to reject the null would indicate the failure of co-integration. The authors were able to reject the null hypothesis of no co-integration at the 5% level for all the countries. They also employed a co-

differenced once in order to be included in models and I(2) variables must be differenced twice.

integration test developed by Shin (1994) and arrived at the same conclusion of co-integration for all the countries. Then they pooled the series and applied the Phillips and Loretan technique to all 18 countries jointly, and found that the variables were co-integrated based on the Shin test. They also examined the residuals for autocorrelation using the Phillips and Perron test and the Shin test. The results were mixed. On the basis of the Shin test, the null hypothesis of unit root was rejected for all countries but Denmark and the U.K.. Finally, they conducted Wald tests and could not reject the null hypothesis that the pooling restrictions are valid. But they noted that the results are suspicious due to the smallness of the sample and concluded that "pooling restrictions are of very doubtful validity (p. 226)". In other words, they postulated that income elasticities are not equal across countries and that there is no evidence for a common trend reflecting technological progress. Their estimates of income elasticities were lower than unity, and they contended that institutional factors are important determinants of the varying country-specific effects, though they stated that the specification of their model does not allow them to "draw any conclusions about which institutional factors may be responsible for varying country-specific effects (p. 226)." Such factors could be the share of inpatient spending in total health care costs, the share of public sector financing, and use of the fee-for-service method of paying physicians, among others.

Unlike the country-by-country approach used by Hansen and King (1996), McCoskey and Selden (1998) wanted to exploit the panel nature of the OECD data. Building upon previous results, which did not reject the unit root null hypothesis for most countries when the conventional Augmented Dickey Fuller (ADF) tests were used, McCoskey and Selden instead employed a new panel data unit root test developed by Im, Pesaran, and Shin (1996, henceforth IPS). The null hypothesis is that all the series contain unit roots against the alternative hypothesis that none does. They claimed that "the gain from imposing uniformity in this respect is increased power to reject the unit root null hypothesis (p.372)." The IPS t-statistic is drawn from the ADF t-statistic; the justification for the IPS method is that it is preferable to other panel unit root tests in that "it allows the data generating processes to vary across countries with respect to ADF coefficients and error structures (p. 372)." Using the Campbell and Perron (1991) strategy for choosing the appropriate number of lagged difference terms for the ADF tests, McCoskey and Selden undertook a country-by-country analysis and replicated the results obtained by Hansen and King, described above. However, when they tested for the joint hypothesis that the OECD countries all have unit root series against the alternative that none does using the IPS test, they rejected the presence of unit roots. They acknowledged the limitations of the IPS test, such as the fact that it does not account for the heteroscedasticity which health expenditures and GDP tend to exhibit over time, but they pointed out that their results "mitigate concerns about the presence of unit roots in models of health care expenditures and GDP (p. 374)". They referred to the need for more robust tests, which are in fact already being developed. Nevertheless, they concluded that "in the meantime, researchers studying national health care expenditures need not be as concerned as previously thought about the presence of unit roots in the data (p. 375)."

Kanavos and Yfantopoulos (1999) investigated the effects of income, growth rates in income, technology, and demographics on the levels of health spending in the EU countries. The approach was a country-by-country, time-series approach, to avoid the methodological problems associated with cross-sectional and pooled cross-sectional analysis, and to avoid the need for a conversion method. Using the 1996 OECD Health database which covers 35 years, the model estimated is:

$$\mathbf{HEX_{it} = f\,(DEM_{it}, HS_{it}, TEC_{it}, OR_{it}, MACRO_{it}, DIET_{it}, PRICE_{it})} \qquad \mathbf{(11)}$$

where the demand for health at time t and in country i, proxied by total health spending (HEX), and the rate of growth of total health spending are the dependent variables. The independent variables are numerous. Variables representing demographic patterns (DEM) in country i included the share of individuals aged 65 and above, male life expectancy, and female life expectancy. Health status (HS) was represented by infant mortality. Advances in technology (TEC) were proxied by the growth of pharmaceutical spending. Growth instead of levels was used because of high correlation between pharmaceutical consumption in each country. The impact of the macro economy (MACRO) was represented by the annual level of GDP and the year-to-year rate of growth of GDP. Prices of various inputs (PRICE) were proxied by the level of relative wage in the health sector and the change in the relative wage. In addition, the total population, the total number of practicing doctors, the number of inpatient care beds and the average length of stay in inpatient care were included as independent variables to estimate the effects of the population, the medical profession, and hospital variables. Tests for co-integration were conducted, and co-integrated relationships between variables were found for all countries. In contrast with earlier studies, the results suggested that, in many countries, GDP (as well as growth in GDP) fails to explain any variation in health spending. In particular, GDP was not a statistically significant explanation of the variation in health spending for Austria, Belgium, France, Ireland, Sweden, and the U.K. Although statistically significant for the remaining countries under study, the income elasticity was less than unity for Finland and Germany and around one for Spain and Greece, and greater than unity only for Italy and the Netherlands.

2.5.3.3 The key findings of co-integration analysis

Much of the available literature has produced conflicting results, particularly in relation to unit root tests, which have a major influence on the performed analysis. The conflicting results regarding unit root tests are principally due to the fact that the work by McCloskey and Selden (1998) omitted the time trends in the Augmented Dickey Fuller (ADF) regressions, whereas Hansen & King (1996), Blomqvist & Carter (1997), and Roberts (1998), include time trends in the unit root tests. While it is not always essential to include time trends in the ADF tests, it has been argued by Hansen and King (1998) that the omission of time trends raises doubts about the validity of the results by McCoskey and Selden (1998), since both health expenditure and GDP are trended. In this case, it is argued, the results obtained by the three other studies are biased and subject to fatal methodological errors.

The co-integration yielded a number of other findings which appear to help with a broader understanding of the determinants of health care expenditures. The first is that the elasticity of demand appears to be at or (slightly) above unity, a finding which confirms the volatility of results and the strong influence of methodology. One study (Kanavos and Yfantopoulos (1999)) finds an elasticity of demand significantly lower than unity in the majority of the countries involved in co-integration analysis, whereas another (Saez and Murillo (1994)) confirms an elasticity significantly lower than unity for 2 of the 10 countries involved in the study.

The second main finding is that the use of Health-PPPs is not necessarily indicated for time series analysis, as its components do not share common trends, and that separate health indices need to be derived from a system whose components share both short and long-term co-movements (Saez and Murillo (1994)).

The third main finding is that the importance of non-income variables has also been confirmed, particularly that of the health price, but also that of technology, as well as the importance of some inputs to the health system. The addition of health system-related variables does not appear to reduce the significance of income as an explanation of the determinants of health care expenditures.

2.6 The relationship between Health Expenditure and other variables

Several other variables have been included in statistical analysis to determine their contribution in explaining part of the variance of health care expenditures. Their inclusion relies mostly on empirical grounds, rather than on the development of a solid methodological-conceptual framework. In this section, we present briefly the available published results but recognize that these present several methodological caveats. A detailed discussion of these caveats takes place in chapters 3 and 4.

Previous work sought to capture the effects of demographic patterns through the inclusion of a variable reflecting the share of population over 65 (or 75) and the share of population under 15, or the dependency ratio defined as the share of the population aged 0-19 and 65 and over as a percentage of the population aged 20-64. Hitiris and Posnett (1992), Hansen and King (1994), Gerdtham et al. (1992a, and 1995), Grubaugh and Santerre (1994), Hitiris (1997), and Kanavos and Yfantpoulos (1999) used one or the other and most obtained a positive and statistically significant impact on health care expenditures. Other authors controlled for demographic patterns through country-dummy variables. Given that improvements in life expectancy are likely to be related to the provision of better care (among many other things), and given the current low levels of infant mortality, Kanavos and Yfantopoulos included male and female life expectancy. Male life expectancy was found to have a negative effect on health expenditures, whereas the impact of female life expectancy was positive. Based on the u-shaped relationship between age and public health care expenditures, Kanavos and Yfantopoulos (1999) also examined the impact of the decreases in infant mortality rates which OECD countries have witnessed during the past 4 decades on health care costs and found it to be negatively related to health expenditure and significant in 7 out of 14 European countries (members of the European Union) examined.

Variables reflecting the impact of lifestyles were employed by a few authors. Tobacco consumption in grams per capita was found to be positive and statistically significant by Gerdtham et al. (1995). Expenditures on alcohol and tobacco per capita were included in Grubaugh and Santerre's study (1994). Whereas the effect of tobacco consumption on health expenditures per capita was positive and statistically significant, alcohol consumption was found to have a negative and statistically significant impact on per capita health spending. However, there is no a priori reason for using the measures employed above (grams per capita consumption; spending on alcohol); if anything, measures such as the proportion of current smokers might be relevant as a potential determinant of health care expenditures at macro level, provided that they are lagged. Less clear is the impact of an alcohol-related variable when analysis is performed at macro, rather than micro, level.

Institutional variables were accounted for in some studies either with the use of country dummy variables as in Hitiris and Posnett (1992), Blomqvist and Carter (1997), and Hitiris (1997), or with the use of dummy variables representing the method of remuneration for outpatient care (fee-for-service, capitation, or salary), and prospective or global budget financing for hospitals as in Gertdham et al. (1992a, and 1995). The results were mixed.

Technology was proxied by the growth in pharmaceutical expenditures in Kanavos and Yfantopoulos (1999), and by a time trend in Grubaugh and Santerre (1994). Other variables included by some researchers are the relative price of health care, the percentage of public expenditures in total expenditure on health, real education expenditures per capita (to reflect the technology of health production in the home), female labor force participation rate (home production variable), urbanization (to reflect lower time and travel costs of health care utilization in urban areas), population density (an environmental variable), and real education expenditures per capita were used by some authors. The detailed list of variables and results are reported in table 2.2.

Finally, few studies from either a developed or a developing country context have examined public health expenditures and/or private health expenditures and their determinants separately. One such study (Musgrove, 1983), using household survey data from six Latin American countries, found that private care had a higher income elasticity of demand than public sector health expenditures, thereby suggesting that private care is a luxury relative to public care and that consumption shifts from public to private, ceteris paribus, as household incomes rise. This may partly be attributed to differences in real or perceived quality, which make public and private health care only imperfect substitutes[18]. "The finding that a higher income shifts expenditure to the private sector is not generally observed at the aggregate level, when countries outside Latin America are also studied" (Murray et al, 1994).

18 Of course, a key difference between this study compared with all the previous ones is that it uses household-level data rather than aggregate data.

Table 2-2 Variables used in models of determinants of health care expenditures

Study	*Dependent variables*	*Independent Variables*	*Results*
Leu 1986	HCE: per capita health care expenditu-res.	-GDP per capita. -Population < 15. -Population >60, or 65, or 70. -Share of public financing. -The degree of urbanization: % of population living in towns over 100,00 inhabitants. -Public beds. -NHS: to indicate centralized health systems. -Direct Democracy.	>0[a]. >0[b]. Never significant >0[b] >0 >0[a] <0[a]. <0[a].
Hitiris and Posnett 1992	HCE: per capita health care expenditu-res.	-Real per capita GDP. -Proportion of population over age 65. -Proportion of HCE that is publicly funded. -A set of shift dummies to capture country-specific fixed effects.	>0 and significant. >0 and significant. >0 and significant. Mixed >0 and <0 results, mostly significant.
Gerdtham et al. 1992*a*	HCE: per capita health care expenditu-res.	-GDPpc: GDP per capita. -Rphc: relative price of health care expressed as a ratio of PPPs for medical care to PPPs for GDP. -DOCpc: supplier induced demand variable, represented by the number of practicing physicians per capita multiplied by 1,000. -IP: share of total health care expenditure used on inpatient health care. -PF: share of total health care expenditure used on public expenditure. -FEE: dummy variable to represent fee-for-service in outpatient care. -GLOBAL: dummy variable to represent global budgeting in hospital care. -AGE: ratio of population 65 years and over to population 15-64 years. -URB: share of population living in towns with over 500,000 inhabitants. -Female participation rates.	>0[a]. <0. <0[b]. >0[c]. <0[a]. >0[a]. >0. >0[b]. <0[b]. Not significant.
Grubaugh and Santerre 1994	HCE: per capita health care expenditu-res.	-GDP per capita. -Population density. -Real education expenditures per capita. -Female labor participation rate. -Per capita real expenditures on alcoholic beverages. -Per capita real expenditures on tobacco products. -The percentage of the population over 65. -The percentage of the population under 15. -A time trend. -Country-dummy variables.	>0[a]. <0[c]. >0. <0. <0[a]. >0[a]. <0. >0. >0[a]. Statistically significant for 5 out of 11 countries.
Hansen and King 1996	HCE: per capita health care expenditu-	-GDP: real per capita GDP. -POP65: proportion of population over age 65. -POP15: proportion of population under age 15.	No long-run relationship between HCE, GDP and the remaining indepedent variables, or

	res.	-PUBL: proportion of HCE that is publicly funded. -RELP: relative price of HCE calculated as the ratio of a health services price index to the GDP deflator.	between HCE and GDP alone for most countries.
Hitiris 1997	HCE: per capita health care expenditu-res.	-Per capita GDP. -Dependency rate represented by the population aged 0-19 and 65 and over as a percentage of the population aged 20-64. -Share of health care expenditure in total public spending. -Dummy variable to account for differences in countries' health service systems. -Rate of inflation (1985-100).	>0[b]. >0[b]. >0[b]. <0[b]. >0[b].
Blomqvist and Carter 1997	HCE: per capita health care expenditu-res.	-Real income. -Country specific dummy variables to account for institutional and demographic variables.	>0 and significant. Share of inpatient spending in total health costs, share of public-sector financing, use of fee-for-service method of paying physicians are important determinants. Institutional organization appears to lead to particularly low spending in Belgium, Denmark, Iceland, Italy. Japan and U.K.
Kanavos and Yfantopou-los 1999	Total health spending on health LHEX. -Rate of growth of total health spending D(LHEX).	Technology factors proxied by -Rate of growth of pharmaceutical spending. Demography factors -Share of individuals aged 65 and above. -Male life expectancy. -Female life expectancy. Health status factors -Infant mortality. Macroeconomic factors -Annual level of GDP. -Year-to-year rate of growth of GDP. Prices -Level of relative wage in the health sector. -Change in relative wage. Population -Total Population. Medical profession -Total number of practicing doctors. Hospital variables -Number of inpatient care beds. -Average length of stay in inpatient care.	>0 and significant in 12 countries. >0 and significant in 8 out of 14 countries. Tendency to have a <0 effect. Tendency to have a >0 effect. <0 and significant in 7 countries. Insignificant in 7 countries. >0 and significant in 6 countries. >0 and significant in 10 countries. >0 and significant in 5 countries, <0 and significant in 5 countries. >0 and significant in 5 countries. <0 and significant in 4 countries. No clear trend. No clear trend.

Gerdtham et al. 1995	-HCE: per capita health care expenditures[d]. -Per capita hospital expenditures. -Per capita ambulatory expenditures. -Per capita pharmaceutical expenditures.	<u>Institutional factors</u> -Dummy variables to represent methods of remuneration in primary care, payment in inpatient care, direct budgetary controls in the ambulatory sector, remuneration in inpatient care, public integrated systems, potential for free setting of medical care prices and over-billing, physicians as gatekeepers, direct payment by patient before reimbursement by insurer. -The proportion of average medical billing paid for by public insurers or paid by public funds, the stock of practicing physicians per 1000 population, the stock of practicing physicians per capita in countries with fee-for-service payments, the proportion of inpatient expenditure of total health-care expenditure, the proportion of public inpatient care beds of total inpatient care beds, public insurance coverage of the population, the proportion of coverage for ambulatory care of state and social security schemes, the proportion of coverage for inpatient care of state and social security schemes, the proportion of coverage for pharmaceuticals of state and social security schemes, the average share of medical care billing paid for by public insurers in ambulatory care sector, the average share of medical care billing paid for by public insurers in inpatient care, the average share of medical care billing paid for by public insurers in pharmaceuticals. <u>Socio-demographic factors</u> -Per capita GDP. -Female participation rate. -Proportion of population 75 years and over. -Proportion of population 4 years and under. -Tobacco consumption, grams per capita. -Alcohol consumption, liters per person. <u>Technology factors</u> -Renal dialyses, rate per million population.	6 results appeared to have significant effects int he expected directions on HCE: 1. <0 effect of the use of primary care gatekeepers. 2. <0 effect on HCE in systems where the patient first pays the provider then seeks reimburse-ment. 3. <0 effect of capitation systems. 4. >0 effect of share inpatient spending to total spending. 5. <0 effect of public sector provision of health services. 6. >0 effect of the total supply of doctors. 0[a]. Not reported. Not reported. Not reported. >0[a]. Not reported. >0.

***Notes*:**
[a] Significant at the 1% level
[b] Significant at the 5% level
[c] Significant at the 10% level
[d] Results are reported in this table only for overall health expenditures as a dependent variable.

***Source*:** Author's compilation from the literature.

2.7 The wider context of the determinants of health care expenditures

In the developing world the examination of the statistical relationship between national income and health care expenditures from a macroeconomic perspective in the developed world has yielded interesting results on the determinants of health care expenditures. While a macroeconomic (aggregate), developed-country perspective has been dominant in the literature, partly due to easy access to data sources, in particular the OECD Health Database, there are two further aspects to this issue: firstly, the determinants of health care expenditures in developing countries and, secondly, the microeconomic (household) perspective, through household surveys. Both aspects and their results are reviewed in the following sections.

2.7.1 Determinants of Health Expenditures in Developing countries

Most of the empirical literature in this field covers the OECD countries and has used the OECD Health database extensively. However, a similar stream of literature has tested the same hypothesis of the interrelationship between aggregate health expenditures and income in developing countries (Dunlop & Martins, eds., 1995). In the case of developing countries, however, data availability is much more limited as is the ability to use a large number of indicators that describe the attributes of different health systems. At the same time, the development of health expenditure data for the developing world has been less successful (Murray et al., 1994), despite attempts by international agencies, such as the WHO, and PAHO, national agencies, such as USAID, and private sector organisations, such as the Sandoz Institute for Health and Socioeconomic Studies, to improve information by promoting household surveys (Zschock et al, 1977; Robertson et al, 1979) and publishing manuals for estimating national health expenditures (Griffiths & Mills, 1982; Mach & Abel-Smith, 1983). As a result, the available sources of information are ad hoc studies or development agency projects. Regional reviews drawing largely on these sources have been prepared for Asia (Griffin, 1992), Africa (Vogel, 1989), and Latin America (1992).

Empirical research in developing countries uses almost exclusively household rather than aggregate data. This in principle allows a close look at health expenditure determinants without the simplifications made by aggregate data. Thus, cross-sectional samples from household expenditure surveys in the mid-1960s found income elasticities of demand for health care greater than unity for Kenya and Uganda (Massell & Heyer, 1969). The study on health financing in Asia by Griffin (Griffin, 1992) has calculated the elasticity of health care spending with respect to per capita GDP for the region as a whole to exceed unity. However, the author does not specify how this figure is estimated, which countries are included in the data set, or the period to which the figure applies. Additional estimates (Musgrove, 1983) found an income elasticity ranging from 1.5 for ten cities in Latin America for 1968, to 1.17 in Brazil for 1974. These results have been supported by another study (Murray et al, 1994) using cross sectional data for 138 countries clustered in eight groups. Data came from the WHO Health for All Database, which relies on individual countries to report data. The analysis focused on the relationship between per capita GDP and public health spending, where an income elasticity exceeding unity was found. It was also established that governments which consumed a larger share of GDP in total also had a higher expenditure on health.

Since the 1980s represented a period in which per capita income in many less developed countries (LDCs) declined, one hypothesis is that health expenditures in these countries may have also declined more than proportionately, particularly among the least affluent parts of the population (World Bank, 1990). Evidence from a number of countries suggests that this is the case (World Bank, 1993), and that the decline occurs both in private household expenditures and in government expenditures for health services, in response to drops in income and tax revenues. In the South Pacific member countries of the World Bank, real per capita health expenditures declined by as much as 75 per cent over the 1980s. Similar declines were also reported in Africa (Vogel, 1989; Vogel, 1990), the Caribbean and Latin America (Musgrove, 1987).

Although the studies cited above do not represent a fully comprehensive review, they suggest that health care spending in developed and developing countries is elastic with respect to income over the range of observations available. Table 2.1, summarises the nature of the research conducted in this field and the results produced in both developed and developing countries.

2.7.2 The Macro – Micro level divide

There appears to be a discrepancy between the macroeconomic (or aggregate) approach, the empirical results that were presented earlier in this chapter, and the micro-economic (or household) approach. While most studies at the macroeconomic level in developed countries have shown an income elasticity of demand exceeding unity, most studies at the micro-economic (household) level in developed and developing countries do not show this result. Indeed, it has been found that the income elasticity of demand for health across households is quite low in developed countries (Andersen & Benham, 1970; Grossman, 1972; Newhouse & Phelps, 1974; Muurinen, 1982; Okunade, 1985; Wagstaff, 1986; and Manning et al, 1987) and in developing countries (Gbsemete & Gerdtham, 1992).

Several alternative theories have been put forward to explain the discrepancy between macroeconomic and microeconomic findings. A study using Canadian data, has attributed this discrepancy to non-price rationing, so that consumers buy less health care than they want and can afford (Culyer, 1988), although this might implausibly imply that high income consumers are more rationed than those with lower incomes. A second, plausible, explanation might be that large health care expenditures are financed primarily by insurance rather than by individuals, and insurance spending rises less rapidly with income. Again, however, from a private insurance system point of view, it has been noted that insurance per se does not necessarily explain the discrepancy between micro and macro income elasticity estimates, as individuals in a private insurance system are restricted by the provisions of their insurance plan (Blomqvist & Carter, 1997). If the higher income of rich families enables them to buy more generous or comprehensive insurance plans than the poor then "there is no reason why spending patterns across rich and poor families would look any different from spending patterns across rich and poor countries" (Blomqvist & Carter, 1997, footnote 1). Finally, Newhouse (1977), explained this discrepancy as "... price is probably not an important rationing factor within many countries at one point in time, whereas it is important between countries and over time". As such, and given that at the aggregate level countries face the "full price" of medical care, one would expect a much stronger relationship between expenditure and income than is obtained in microeconomic studies.

2.8 Concluding remarks

2.8.1 The main findings from the literature

This chapter has revealed the wealth of empirical evidence examining the interrelationship between health care expenditures and a series of potential explanatory variables over the past forty years. Looking at each type of analysis individually (cross-sectional, pooled cross-sectional, and time-series) and at the results that have been obtained, it is fair to say that significant conflicts arise, both with regards to each type of analysis and across analytical methods.

The main results of this literature stream can be summarised as follows:

First, the empirical literature comprises cross-sectional, pooled cross-sectional and time-series analysis. Whereas early investigations focus on the aggregate relationship between health expenditures and GDP only (simple regression analysis), subsequent analyses include further variables as potential determinants of health care expenditures (multiple regression analyses), both institutional and non-institutional. Furthermore, the sophistication of statistical analysis has increased over time, ranging from simple regression analysis, to multiple regression modelling and dynamic specifications, such as co-integration and error-correction models. In the majority of cases, it appears that national income per capita, measured by Gross Domestic Product (GDP) per capita is the single most important explanation of the variation in health expenditures and that the income elasticity of demand for health care was found to exceed unity in the majority of studies, thereby leading to the conclusion that health care is a luxury good.

This result is subject to qualifications, which mitigate its robustness across countries and over time. The most important qualification seems to be related to the method of analysis. Researchers have been experimenting with different types of econometric techniques, that is, cross-sectional, time-series and pooled cross-sectional analysis; the results have been shown to be sensitive to the methodology used. Income elasticity of demand exceeding unity was common in bi-variate and multi-variate cross-sectional analyses, and less common in pooled cross-sectional and time-series studies. Overall, the initial overwhelming evidence about the income elasticity of demand for health care being greater than unity began to fade in later studies, so that hypotheses have been advanced that health care is neither "a necessity" or "a luxury", but, somewhat implausibly, "both" since the income elasticity varies with the level of analysis (Getzen, 2001). However, regardless of the value of the elasticity, income was found to be positively correlated with health expenditure and statistically significant.

Second, other variables, in addition to income, were found to be significant explanatory factors, including, among others, the number of doctors per capita, the relative price of health, the number of beds per 100 population, the length of stay, infant mortality, the share of elderly in the population, the share of people under 15 in the population, and the female workforce participation rate. The results obtained, are however, contestable and relationships are inconsistent. This reflects the absence of a theoretical framework underpinning the empirical analysis and the multiplicity of hypotheses tested within a single empirical model. Another concern is the use of large numbers of dummy variables. Authors make excessive use of dummy variables without taking into account the well-known problems related to their use, particularly the problem of interrelationships between dummies.

Third, researchers have also been using different conversion factors (exchange rates, Health-PPPs, GDP-PPPs) in order to compare macroeconomic variables. The results are often sensitive to the choice of conversion factor. The literature is conflicting about the validity of different conversion factors, which seems to depend on the type of econometric analysis and the year(s) the analysis takes place. Generally, it has been accepted that the use of PPPs may be superior to exchange rates, both in cross-sectional and pooled cross-sectional analysis. Again, this finding became the subject of considerable scrutiny, as the literature was not conclusive, giving rise to debate on conversion factor instability. On theoretical grounds, the use of PPPs as a conversion factor has been favoured over exchange rates, but the use of both GDP-PPPs and Health-PPPs to convert GDP and health expenditures respectively was found to be the most adequate methodology of rendering results that would withstand scrutiny, although, again, the use of Health-PPPs was questioned on statistical grounds in a recent time-series study. Overall, the empirical evidence has largely been inconclusive about whether one measure is definitely superior to the other.

Fourth, there seems to be a discrepancy between "macroeconomic" (aggregate) studies and "microeconomic" (household or regional) studies in what concerns the size of the income elasticity of demand. In the latter, a value smaller than unity is typically obtained, in the former, a greater-than-one value is the most common result with the qualifications mentioned above. A variety of inconclusive, explanations have been offered for this discrepancy at different times.

Fifth, while there is much published evidence on the determinants of total health care expenditures, very little is known about the determinants of total public health care expenditures and total private health care expenditures individually. Indeed, these have not been explored at all over time. Yet, this seems rather surprising, since the dynamics of publicly funded systems and privately funded systems, which very often co-exist in many countries, may be different.

Sixth, there is a clear lack of a theoretical foundation to the statistical analyses performed in this field, with no attempt to establish one other than the application of microeconomic principles to analyses that are macroeconomic in nature.

Seventh, several of the reviewed studies have drawn criticism because of misspecification problems and variable omissions in the analytical models, but further issues remain unresolved. These relate to the actual choice of variables and their comparability across countries and over time. They also relate to the lag structure in individual models, which often appears to be contrary to what (economic) theory would predict. A characteristic example in this context is the relationship between income and health care expenditure. If one accepts the validity of public choice theory, as many authors have done, then current levels of health care expenditure should be determined by past levels of GDP plus the trend of GDP or its growth, rather than current GDP levels. Yet, there is not a single study in the literature that has tested this particular hypothesis.

Eighth, there appears to be a great deal of concern about the economic interpretation of an elasticity of demand greater or smaller than unity and the robustness of econometric technique in deriving one or the other, but what is conspicuous by its absence, is the policy relevance of the findings obtained and how they could be translated into policy recommendations for individual health systems or groups of health care systems.

Ninth, some authors have tested the significance of lifestyle variables and the impact they may have on health expenditure. Incorporating variables such as per capita consumption of tobacco, litres of alcohol per capita, or grams of fat per capita, is naïve for two reasons: first, the choice of variable is far too crude to yield results at the macro level. Second, lifestyle variables impact human health with a (significant) time lag, which is also dependent on exposure to other risk factors. The empirical literature has not included any lag structures in the models used; neither has it included other risk factors to test for likely interactions.

Finally, a significant proportion of the empirical analysis seems to be driven by the availability of data. This begs two related questions: first, can the available data be better utilised so that it can make better sense for policy development? Second, what improvements might we need in order to better analyse and understand the determinants of health care expenditures?

2.8.2 The way forward on the determinants of health care expenditures

In light of the above results, the thesis aims to progress in the following ways: first, it will analyse methodological problems that, to date, have not been recognised by the literature and that severely limit the predictive power of the analyses so far. These problems relate to the measurement of key variables, such as GDP, health expenditure, and Health-PPPs, among others. Second, it will develop a theoretical framework, which can be used in the analysis of the determinants of health care expenditures. Third, in addition to the determinants of health care expenditures, it will investigate more closely the question of the determinants of public health care expenditures that has to date been completely neglected. Fourth, it will pursue a time-series analysis of an aggregate demand function by country, which avoids the misspecification and estimation problems that have been highlighted in the previous sections and the methodological problems that will be explored in the next two chapters. This will also make sense from a policy perspective and for the countries that will be included in the analysis, as, to date, governments have not actively engaged in estimating the likely impact of macroeconomic and health-related factors as well as projecting future resource requirements in light of macroeconomic, demographic, technology and other changes. There are two notable exceptions: first, the Congressional Budget Office (CBO) annual budget assessments in the United States and the recent Wanless report in the UK, on sustainable financing

(Wanless, 2002). The latter is of particular importance, as it is the first ever evidence-based assessment of the long-term requirements for the UK National Health Service, whereas in the former case, the CBO routinely conducts budget assessments which also include expenditure on health services.

In pursuing an aggregate (macroeconomic) type of analysis, its limitations are recognised. The thesis will not address the question of the discrepancies between income elasticities of demand in macro- and micro-economic studies, but the gaps and inconsistencies that the literature on aggregate demand for health care has revealed. To that end, the thesis will use the same data sources as those used by other researchers, but it will also point to the direction of gaps in these data sources.

CHAPTER 3 METHODOLOGICAL PROBLEMS IN THE ESTIMATION OF THE DETERMINANTS OF HEALTH CARE EXPENDITURES: A WAY FORWARD - PART I

3.1 Introduction

The previous chapter explored the large body of academic literature that has attempted to analyse the determinants of health care expenditures in different countries and over time. This body of literature dates from as far back as the early 1960s and is continuing to develop until now. Other than noting the absence of a theoretical framework, chapter 2 highlighted a number of conclusions from this literature. Among them were:

(a) a variety of different estimation techniques (cross-sectional, pooled cross-sectional, and time-series) have been used, each producing different results;

(b) There has been an empirical "search" for factors, other than income, that may determine the variation in health care expenditures within or across countries and over time;

(c) "Macro and micro" perspectives produce a discrepancy in the size of the income elasticity of demand;

(d) A wide range of different conversion factors have been used, again generating different results;

(e) Many of the models used appear to be mis-specified; and

(f) There is a general lack of policy-relevant conclusions and recommendations.

As well as the many significant defects associated with mis-specification and poor functional form, there are further intrinsic methodological defects, which have almost entirely been ignored. The purpose of this chapter and the next is to explore the nature of these defects in detail. Specifically, this chapter has four main objectives:

- first, it will provide a critique of the theories that have been used to justify the empirical research and will argue the case for a more robust theoretical framework. In a subsequent chapter (chapter 5) a theoretical framework for analysis will be developed.
- Second, it will assess the relative advantages and disadvantages of different estimation methodologies (cross-sectional, pooled cross-sectional, and time-series analysis), with a view to deciding which one offers the best possibility of robust and policy relevant empirical estimates that would also allow cross-country (cross-system) comparisons.
- Third, it will highlight the imperfect nature of current conversion factors and then discuss the usefulness of different conversion factors employed in cross-country comparisons
- And, finally, it will discuss the use of health prices and price indices in the literature, with a view to deciding on which of these indices would be most appropriate in cross-country comparisons.

Section 2 discusses the theoretical framework employed so far by those undertaking statistical analysis; section 3 analyses the problems associated with estimation methods, conversion factors and health prices, and section 4 draws the main conclusions and looks for ways forward.

3.2 The theoretical framework

3.2.1 General observations

In any analysis it is important first to establish a conceptual framework and then to examine to what extent relevant concepts can be operationalised. Although a testable hypothesis can be induced from observations of the relationship between health expenditure and GDP, such a theoretical framework has never been established. In the existing analyses, all health expenditure (public and private) is treated as a behavioural variable, similar to private consumption and expenditure. To some, extent, therefore, the results are based on an empirical observation that largely reflects Wagner's law, namely that an increase in national income causes an increase in public expenditure, mainly through an increase in the demand for public services (Leidl, 1998).

An additional conceptual problem is that authors use aggregate macroeconomic demand functions but interpret their results according to microeconomic theory. This assumes the possibility of summing all linear household demand equations to a single total market demand equation. While this is theoretically possible, it can only be fulfilled under certain rather strict conditions, assuming, among others, the same or similar consumption rates for all households, the same public-private mix, and the same mix of health services across countries. Consequently, the interpretation of income elasticities of demand should be treated with caution, as it does not necessarily follow that macroeconomic relationships will be observed at a microeconomic level (Deaton & Muellbauer, 1980). Thus, there has been a confusion between macroeconomic and microeconomic approaches without defining whether the so-called demand for health refers to an aggregate approach based on macroeconomic thinking, or is simply derived from utility maximization, based on the Grossman hypothesis, aggregating individual preferences and demands.

3.2.2 The Macro-Economic Foundation

The early studies by Abel Smith (1963, 1967), Kleiman (1974), and Newhouse (1977) adopted an aggregate macro-economic approach based on Public Finance and International Economics. The law of increasing expansion of the public, specifically state-funded activities was defined by Wagner in 1883, and was subsequently known as "Wagner's Law". He estimated a statistical model based on a time series sample from a number of western industrializing countries:

$$\mathbf{G/Y = a + b \{ Y/N \}}$$

where

G/Y Government Share

G= Government spending

Y= Income

N= Population

a and b are parameters to be tested

This basic conceptual framework has undergone subsequent refinement. Musgrave (1969, 1985) elaborated Wagner's law by arguing that in order to examine the hypothesis that budget growth has been excessive, the concept of "correct" budget size must first be defined and established. The argument here is that the appropriate share of the budget will change over time due to demographic and technological changes, changes in relative costs, and the growth of personal income. The optimal level of redistribution, in turn, may change with changes in the distribution and level of income. It will also respond to changes in social attitudes, i.e. predominant views of distributive justice. Since there are many reasons why the optimal share for budgetary activity may change, an observed increase in that share is not necessarily a proof of excess [19]. Musgrave (1985) also examined the share of public expenditure during different phases of socio-economic development, and tested a number of hypotheses, namely the existence of voting bias and the behaviour of public officials as "bureaucrats" as further sources of excessive budget growth. These factors imply institutional inertia and the desire of civil servants to accumulate more power through increased resources. Similar analyses have been carried out by many other authors (Rao, 1986; Rao, 1987; Wagner, 1976; and Peacock & Wiseman, 1961, among others).

Although Abel Smith (1963, 1967), Kleiman (1974), Newhouse (1977) and others do not explicitly refer to Wagner's Law or, in the case of the latter two, to Musgrave's early work, the basic research question remains the same, namely how can one identify the causes and factors that contribute to the expansion of the health sector? These three authors explored the relationship between per capita health expenditure and per capita GDP, using a limited number of statistical observations based on small samples (33 countries/observations for 1961, 16 countries/observations for 1968, and 13 countries/observations for 1968-1972, respectively). Abel Smith (1967) depicts scatter diagrams for his chosen sample of 33 countries, including developed (USA, Canada, Sweden), less developed (Tanganyka, Ceylon) and Eastern European countries (Yugoslavia, Czechoslovakia). He approximates the Engel Curve[20] by estimating various forms of the model:

19"Excess", given the nature of technological innovation and the changes in demographic structure is not a notion that can be quantified with precision. Strictly speaking, it is the year-on-year change in the budget over and above the rate of inflation.

20 The Engel curve lies at the center of the discussion on the income elasticity of demand. Appendix 1 to this chapter discusses the Engel curve, how it is derived and what it means in practical terms. In a nutshell, the Engel curve shows the relationship between a consumer's income and the quantity of a good bought.

Total Health Expenditure/ National Income = f(Per capita Income in (US $))

The analysis is restricted to a regression line fitted to a scatter diagram without making reference to the estimated parameters.

Kleiman (1974) followed Abel Smith and used a sample of 16 developed and less developed countries bundled together in a model. The relationship between per capita health expenditures and per capita income was estimated and a high coefficient of determination was found ($R^2 = 0.96$), implying that 96 percent of the variation in per capita health care expenditures across Kleiman's sample could be explained solely by per capita income. In a similar vein, Newhouse (1977) used of a sample of 13 countries and also found a significant relationship. His estimated income elasticity is 1.31 implying that health care is a luxury good.

The literature on the determinants of health care expenditures developed further during the 1970s, 1980s and 1990s. The consistent message was that after adjustment for inflation, exchange rates and population change, GDP per capita remained the main determinant of health expenditure.

3.2.3 The Micro-Economic Foundation

In the micro-economic framework the evolution of health expenditures is explained with reference to the theory of consumer's utility maximization and demand analysis. Grossman (1972) provided a substantial theoretical framework to argue that the demand for health care is derived from the demand for health, which is the outcome of a health production process influenced by education, habits, diet and other lifestyle variables. The consumer of health services is thus also a producer of a certain level of health status. The estimation and interpretation of income elasticities and other parameters related to the determinants of health expenditures becomes a difficult task because, while it is feasible to derive micro-economic implications from aggregate analysis, the necessary assumptions are extremely restrictive. In particular, two restrictions are necessary in order to enable aggregation. The first requires that the distribution of income is the same across the countries under study, and the second requires that all consumers have identical utility functions. These restrictions are too stringent, given evidence by Kleiman (1974) that income inequalities do affect the consumption of health care, and that consumers display dissimilar preferences within and among countries. In addition, it is necessary to assume that health care delivered is the same in every country to enable aggregation where data from different countries are pooled. In reality, countries differ considerably in their mix of inputs and outputs, in ways that cannot be explained solely by definitional problems. Pooling a group of countries therefore "might lead to biased estimates" due to the strong restrictive assumptions described above (Parkin et al, 1987).

In general, the relationship between health care expenditure and the independent variables examined in these studies is of the form:

$$\mathbf{HCE = f(Y, D, X, L, S, G, I)}$$

Where Y is income per capita, D includes demographic factors (e.g. population age structure), X is a vector of other variables describing the stock of health care inputs (e.g. number of physicians, nurses, hospital beds, etc), L is a vector of variables describing lifestyles (e.g. consumption of tobacco, alcohol, exercise, consumption of fat, etc), S represents organisational variables of the health care system, G is the share of public expenditure relative to total health care spending, and I is the rate of inflation.

In the subsequent analysis I explore criticisms of the basic micro-economic approach, which are frequently ignored or even violated in a large number of empirical studies. Some authors have recognised that previous findings in the literature, that health care is a luxury good, are due to the application of microeconomic analysis to aggregate data.

The first economic assumption made by applied researchers is that utility functions are homothetic. Homotheticity of utility functions implies that there are identical individual preferences across countries; it also implies that the marginal rate of substitution between two different bundles of commodities (x1 and x2), is identical across countries, hence for two OECD countries, say France and Greece, it would hold that

$$(dx_1/dx_2)_{greece}=(dx_1/dx_2)_{france}.$$

Assuming that x1 is ambulatory care and x2 is hospital care, then homotheticity implies that the rate of sacrifice of hospital care in order to get an extra unit of primary care, while keeping utility constant, is the same across all countries. However, the development of ambulatory and hospital care across countries is not the same and the spectrum of services within primary and within secondary care varies significantly. Hence, goods x1 & x2 are not homogeneous across countries, and the rate of substitution is not really comparable.

Second, it is implicitly assumed that the proportions of various types of services (for instance hospital care and primary care) are fixed, namely the ratio of Qhi/Qpi is fixed in all countries involved in statistical analysis (where Qhi is the amount of hospital care in country i and Qpi is the amount of primary care in country i). However, allocation of resources differs greatly between countries. That implies different utilisation of services and, furthermore, different methods of operation of the health system in different countries. Thus, the relative development of primary and secondary care varies across countries. Specifically in European Union (EU) countries, greater emphasis has been given to secondary care in the southern and to primary care in the northern Member States. There are also many definitional problems, with a condition managed in the primary (health) care sector in one country but in the secondary (health) care sector in another, or even in different ways within the same country and over time. Hence the rate of substitution between the two sectors cannot be identical in all countries. In addition, there are different balances of institutional and household care in different EU countries, which in a cross-section or pooled data analysis remain unaccounted for. Again, the North-South divide within the EU highlights the differences, with some northern countries having more developed institutional care, while the southern countries have traditionally relied more on household care.

Third, a corollary of homothetic utility functions is that technology is treated as given. This assumes that all countries have similar levels of technology, and that they all introduce and assimilate innovations at the same time. For instance, a new surgical procedure pioneered in the US becomes immediately available in all countries, or the uptake of new pharmaceutical treatments is the same by all countries involved. Assuming that all this is happening, decisions are taken in a (health) technology neutral environment, where technological advances remain unaccounted for. It is nevertheless well established that the intensity of use of technology as well as the uptake and assimilation of technological advances vary significantly among countries. Furthermore, the technology of producing different types of inputs such as doctors and nurses varies, and this can be attributed to different educational standards across countries. Thus, for instance, the augmented human capital in nursing personnel is very different among countries. In the Nordic countries and the UK, nurses have typically assumed extended and increasingly technical roles, whereas in some Mediterranean countries their role is more constrained. This is reflected in differences in basic and post-basic educational curricula. In addition, the extent of substitution among professionals varies due to differences in the production processes of health services. In some countries the nursing profession has assumed an increasing amount of what previously was considered a medical function, such as prescribing [21], while in others it has a purely auxilliary function.

Fourth, with respect to the interpretation of results, a problem arises from the use of the Engel curve interpretation. Engel curves record the relationship between income and the quantity of a good X purchased. Homogeneity of demand is assumed as a direct result of the utility-maximization assumption. If the fraction of expenditures devoted to X increases (declines) as income increases, the good is labelled a luxury (necessity) good (Nicholson, 1995). The term is also used for the relationship between income and expenditures on a good, which makes the further assumption that prices are fixed. But Parkin et al. (1987) showed that price variations have a major effect on the relationship between income and health care expenditures. They regressed numbers of physicians, dentists, nurses and midwives, and pharmacists per 100,000 population on GDP in order to isolate the relationship from price effects. The results showed that "the suggestions that prices are unimportant no longer has much justification (p.124)," because "levels of GDP per person are markedly less successful in explaining variations in these real volume measures than they are in explaining differences in expenditures (p.115)." The implication is that a multivariate model of health expenditures must be used which accounts for price effects[22].

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21 For instance nurse prescribers in the UK and a similar nursing function in Canada.

22 A further implication relates to the use of the Engel curve interpretation. The interpretations of results related to Engel curves are based on a cross-section of incomes of individuals or households whose demand is assumed to be homogeneous. The aggregate national data on health are not developed enough to be regarded as a very highly aggregated econometric model of individual behaviour. Therefore, using the Engel curve interpretation for estimates obtained from aggregate health care data is questionable.

Fifth, it is assumed that relative prices are fixed (for instance hospital care prices and primary care prices are fixed) and price ratios are the same in different countries. Thus, the relative shares of expenditure are assumed to be fixed, so that, for instance, the ratio of PhiQhi/PpiQpi (where PhiQhi is hospital expenditure in country i, and PpiQpi is primary care expenditure in country i) is the same in all countries. Fixed relative prices imply that the ratio of prices remains the same across countries; this is based on the assumption that the markets for all health goods and services are identical, which means that there is the same degree of competitiveness as well as the same degree of bargaining power among professions. However there are considerable differences among countries based on: firstly, the monopsonistic power of the state which purchases goods and services offered by health care providers; secondly, the monopolistic powers of the medical profession, which varies across countries; and thirdly, in southern European countries there is a significant underground health economy[23], where a considerable amount of health transactions, especially in surgery, take the form of informal payments. Two striking examples from southern Europe are Greece (Abel Smith et al, 1994) and Spain (De Miguel & Guillen, 1989). Such transactions influence not only the absolute level of fees given to specialists but also the price ratio of different inputs since payments to other health professionals, e.g. nurses, are minimal. Thus, health care is not a homogeneous good but very heterogeneous and this is something the empirical literature has largely ignored.

Sixth, the distribution of income is implicitly assumed to be the same within and among all countries. Yet, income distribution varies within each country. High levels of poverty may

23 The phenomenon of an informal health economy may be even more widespread in Eastern European countries in transition and other parts of the world and a body of literature has been developed to account for these and measure their extent. The choice of southern European countries in this context, reflects the existence of this phenomenon in developed, OECD economies.

imply higher aggregate health need, the distribution of which must also be considered. In particular, poorer social groups have been found to have higher rates of disease and premature death in comparison with higher socio-economic groups (Le Grand, 1987; Le Grand & Illsey, 1987; Benzeval, Judge & Whitehead, 1995; and Feinstein, 1993, among others). In fact "there is now a very extensive international literature on health inequalities, which, in brief, shows that in all industrialised countries, the poor are more likely to suffer disabling ill-health and premature mortality than are the rich" (Leon and Walt, 2000).

Methodologically, the issue of income inequality would, in principle, require single country analysis, unless data can be standardised across countries[24]. As Atkinson (1996) points out, estimates of the degree of income inequality, are not comparable across countries. One can thus draw few conclusions from the relative degree of inequality in different countries. Data are drawn from national surveys of income inequality, many of which fail to account adequately for non-cash benefits, transfers, and other relevant factors, and which often vary in the extent to which they include the tails of the distribution.

Seventh, there is little or no reference to stock variables, whether with regard to the provision of health care or to population health. Lifestyle and material circumstances are major determinants of health and their consequences will inevitably have an impact on the level of health spending. However, the nature of this relationship is far from straightforward and there is a variable lag period, but in some cases, events around the time of birth may have consequences that only manifest in old age. In recent years, there has been a much better understanding of the complexity of these relationships (Leon and Walt, 2000), but this has

24 Issues such as type of income (gross versus disposable), or household size, or transfers, need to be standardised across countries, if cross-country comparisons are to make sense. This is possible, but may be resource intensive.

not been incorporated by those who have sought to take account of the relationship between lifestyle and health expenditure.

In summary, contrary to assumptions made about Engel curves and the homotheticity of utility functions, the majority of empirical analyses have been atheoretical. Yet, economic theory may help explain more clearly the factors affecting demand for health, and, hence, health spending, and whether variation in health spending is underpinned by a particular theoretical framework. The optimal approach is to develop a theoretical model and to test it empirically. Furthermore, the empirical literature does not provide an adequate explanation about why health care expenditures have continued to rise for a long time in most tax-, social insurance-, and voluntary insurance-financed systems, either in pecuniary terms or as a proportion of national resources (e.g. as a proportion of GDP). Whether the share of national income devoted to health care will continue to rise ad infinitum is an issue that is not addressed[25].

3.2.4 The value of the income elasticity of demand

As noted in chapter 2, the question of what is the value of the income elasticity of demand for health care and whether it may exceed unity has become the subject of considerable debate. Indeed, several studies focus solely on its size. While it can easily be derived from regression coefficients, the interpretation of the income elasticity of demand can mislead. This is so because what is interpreted as income elasticity of demand is not a true income elasticity of demand. The conventional definition of the income elasticity of demand implies a percentage increase in quantity of a good demanded, for a given percentage change in income, or:

25 Although, surely, it can never exceed 100% of GDP in the long run!

$$\epsilon_Y = \frac{dQ/Q}{dY/Y} \qquad (1)$$

Where ϵY is the income elasticity of demand, dQ/Q is the percentage change of quantity demanded, and dY/Y is the percentage change in income. The majority of empirical studies relate changes in income to changes not in the quantity of health care demanded, but in the amount of expenditure on health care. Expenditure on any good or service is equivalent to price times quantity (P x Q). Therefore, the income elasticity of expenditure that results from this relationship is not necessarily the same as the income elasticity of demand. If the income elasticity of expenditure were to be the same as the income elasticity of demand, then we would have to assume that prices (P) are constant. But prices do not remain constant over time[26], which means that it is important to take account of how they change. This is usually done by deflating real sums by purchasing power parities. Relative prices are important in health care because, in line with other service sectors, increases in costs may be difficult to offset against productivity increases and technological change.

3.2.5 Final remark on the theoretical model and way(s) forward

A causal relationship is widely assumed between health care expenditure and GDP. The nature of this relationship is not, however, underpinned by a coherent theory, although it implicitly draws upon elements of macroeconomic and microeconomic theory. The lack of conceptual framework means that statements about variation in health care expenditure among advanced industrial nations are likely to be statements of tendency (Rose, 1991; Etzioni, 1985). Furthermore, the acceptance of a causal relationship between health

26 Particularly health services and health goods are characterized by higher price inflation both because of the non-tradability of health services within markets and the absence of markets in many settings, and the innovativeness of new health care products (pharmaceuticals, diagnostics, medical devices, etc), which frequently results in significant price premia over existing technologies.

expenditures and GDP deflects attention away from the need for more informative analyses that would focus attention on the determinants of variations in the coverage and composition of health services, including micro-efficiency and resource allocation. As a result, the policy relevance of the literature in this field remains very limited.

Chapter 5 will take this discussion further and will outline a conceptual framework that would encompass the aggregate determinants of health care expenditures, which will subsequently be tested empirically in chapter 6.

3.3 Key methodological problems in the empirical research

3.3.1 General observations

Aside from the lack of a theoretical foundation and conceptual framework, the validity of an empirical observation relies greatly on the credibility of the data, and the robustness of the methods used to analyse them. The quantitative literature on the determinants of health care expenditure raises a number of important methodological issues pertaining to the data, the type of conversion factor, the prices of health service inputs and the method of estimating health production functions.

The literature on the determinants of health care expenditures has focused a great deal of attention on the aggregate relationship between gross domestic product (GDP) and the level of health spending. Both of these parameters are examined in more detail in chapter 4. The early literature in the area (Abel-Smith, 1963, 1967), showed that, after adjustment for inflation, exchange rates and population, GDP per capita is a determinant of health expenditure and that most of the variation in health spending was attributable to variations in real per capita income. This proposition was tested econometrically by many authors

(Newhouse, 1977; Maxwell, 1981; and Leu, 1986, among others) and it was confirmed that, in aggregate terms, spending on health rises faster than national income, hence the income elasticity of demand for health care is greater than unity, thereby implying that health care is a luxury good. There are three main issues arising from the research effort so far, relating to the analytical methodology, the attempts to standardise data from different countries, and the type of model used to analyse the variation in health care expenditures.

3.3.2 Estimation methodology

The choice of statistical technique used to analyse the determinants of health care expenditure in different countries affects the way conclusions are drawn for policy analysis. As I mentioned in chapter 2, three methods have been used and have claimed various degrees of success in explaining variation in health care spending:

- Cross-sectional analysis
- Pooled cross-sectional analysis
- Time-series analysis

In particular, a large number of studies have examined the relationship between health spending and income, occasionally adding other variables, among a number of countries at a specific point in time (Newhouse, 1977; Leu, 1974; Maxwell, 1981; Gerdtham, 1988; Parkin et al, 1987). Other studies used a pooled cross-sectional analysis, namely looking at this relationship for a number of countries and for a number of years (Gerdtham, 1991; McGuire et al, 1993; OECD, 1995). Finally, very few studies exist so far that look at the determinants of health expenditures on a time series basis for individual countries (Murillo et al, 1993; Saez et al, 1994). The main result so far is, in the aggregate, a confirmation of the earlier empirical finding that health care is a luxury good across countries (see Table 2.1), both in the developed and the developing world, and that health spending is largely determined by national income. However, the special features of the health care sector and the frequent lack of available data for many variables have called into question the robustness of the results of empirical research (Kanavos & Mossialos, 1999). In addition, the result does not appear to be robust and, at times, a different choice of years or conversion methodologies produces the result that health care may not be a luxury good. In addition, all empirical research to date has ignored the correlation between health expenditures and GDP that may simply be due to the former being a component of the latter. These factors all pose questions about the credibility of the existing empirical results.

3.3.2.1 Cross-section analysis

Cross-section analysis has so far been used very widely. Over the years, the simple relationship between health spending and income, underspecified as it is, has expanded to include other variables, such as the proportion of elderly (aged 65 and above), the number of working women, etc. The use of cross-sectional data in the literature brings together countries with different initial conditions and, quite often, different income levels. It implicitly assumes that all countries have similar technologies, similar health production functions and allocation of resources, and the same public-private mix. The robustness of the results of cross-sectional analysis also depends on the validity of the conversion factors and the comparability of the original data. Given the points already raised, it is not surprising that the use of cross-sectional data has produced different results at different points in time even when the same countries are being studied. The results produced by Parkin et al (1987) and Gerdtham & Jönsson (1992) are typical in this respect; both studies use Health- and GDP-PPPs, but the former paper finds an income elasticity smaller than one using 1980 data, whereas the latter, using 1985 data, finds health care to be a luxury good, with a demand elasticity considerably higher than unity (1.43). The choice of conversion factor also gives different results: Parkin et al (1987) found that health care was a luxury when exchange rates were used as a conversion factor, whereas it was observed to be a necessity when Health- and GDP-PPPs were used to convert health spending and GDP respectively.

Cross-sectional analysis, although in principle useful, is static in nature in that it examines a given relationship at a specific point in time and ignores dynamic effects and initial conditions unless the same type of analysis is undertaken, at different points in time. As health care reform has gained considerable impetus over the last fifteen years, decision-makers would be interested in what actually works on a continuous basis, rather than any static, short-term effects, which may be reversable in the medium- or long-term. Although pooled cross-sectional and time-series analyses may often face similar disadvantages as cross-sectional analysis, models that account for dynamic effects and initial conditions can rectify this, thus making the latter two types of analysis attractive relative to cross-section analysis.

3.3.2.2 Pooled cross-section data analysis

In recent years there has been considerable increase in the use of pooled cross-sectional studies, which allow analysis of a sample of countries over a period of time. From an econometric perspective the advantages of using pool cross-sectional data are well documented in the literature (Chamberlain, 1982; Anderson & Hsiao, 1982; Hsiao, 1985; Hsiao, 1986; and Baltagi, 1996). A pooled cross-sectional data set gives the researcher a large number of observations (data points), increases the degrees of freedom and reduces the collinearity among explanatory variables[27], thus improving the efficiency of econometric

27 Collinearity is a phenomenon, whereby an explanatory variable can be expressed as an exact linear combination of the other explanatory variables. In this particular case, the explanatory variable in question is redundant. In time-series and pooled cross-section analysis, it needs to be determined that: (a) the no-

estimates. This, in turn, means that the variable coefficients obtained are more likely to be robust and free of biases when countries are the unit of analysis, samples are often small, the information provided by them may not be rich enough to meet the requirements of the model specified, and that may give rise to the problem of multicollinearity and small sample bias. In this case, the researcher can either (a) increase the sample information or (b) reduce the information requirements of the model. In the case of the determinants of health care expenditures, a simple way of increasing the amount of information would be to pool countries over the same time period. Reducing the information requirements of the model can be done, for instance, by imposing prior restrictions on the parameters and their coefficients. For example, the value of a certain parameter in the model can be assumed to be zero.

Pooled cross-sectional data, by offering many more degrees of freedom, can reduce the gap between the information requirements of a model and the information provided by the data. Furthermore, it may be very useful in the particular case in econometric research where the real reason for certain effects is omitted variable bias. By utilising information on both the intertemporal dynamics and the individuality of the relationships being investigated, it is possible to control to a certain extent the effects and problems of missing or unobserved variables. On the other hand, pooled cross-sectional analysis is not without its disadvantages. One such disadvantage may be the danger of amplifying measurement error problems. Measurement error problems can, in turn, lead to biased estimates through selection bias (Nickell, 1981; Anderson & Hsiao, 1989). Furthermore, the methodological problems of assembling data on heterogeneous systems are still not dealt with regardless of the type(s) of modelling techniques available.

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multicollinearity assumption holds and (b) that the dependent variable is exogenous to the independent variables.

3.3.2.3 Time-series analysis

Compared to a cross-sectional and pooled cross-sectional analysis, a country-specific time-series approach may have advantages in that it focuses on explaining a health production function within an individual country and may provide information on dynamic patterns and the consequences of policy over time. In this respect, the effects of specific policy decisions and relevant underlying trends or habits can be incorporated into the analysis and their effects evaluated. One of the main advantages of time-series analysis is, therefore, that it can account for effects that may take time to appear in a health production function.

For the reasons already discussed, a time-series methodology is coupled with a single country approach. Policy analysis should aim for knowledge about the exact consequences of macroeconomic change, income and its distribution, the structure of health service provision and levels and distribution of health for the propensity to spend on health. This, we would argue, is achieved by studying these determinants within each country over a period of time. In these circumstances, exchange rates and PPPs are made redundant by the use of domestic currency values.

Inevitably, time-series analysis has a number of conceptual and methodological disadvantages. Many macroeconomic data series are subject to underlying trends. Such time-series are thus non-stationary and non-stationarity makes linear regression problematic. A stationary time-series is one that has a constant mean, a variance that is less than infinity, and a covariance that does not depend on time. In other words, the process by which the data are being generated is the same over time. Most time-series are found to be integrated of some order I(d), which means that the series must be differenced d times in order to become stationary. If a time-series is non-stationary, the conventional hypothesis testing procedures based on the critical values of the t and F statistics may be suspect (Harvey, 1989). Furthermore, one would erroneously observe a good fit between non-stationary variables because the R^2 statistic is biased upwards. This could account for the strong relationship found between health expenditure and GDP in time-series analyses, which did not account for potential non-stationarity. In view of the problems with non-stationary variables, appropriate techniques are therefore essential to avoid mis-specification and estimation biases.

A further methodological issue is that the use of time-series analysis requires datasets that can incorporate variable lag structures. However data may not be available easily, or in a consistent form for the desired periods. A particular problem arises with attempts to incorporate variables relating to determinants of health, such as diet, tobacco and alcohol consumption, in long-term econometric analysis.

3.3.2.4 A final remark on estimation methodology

The discussion around the use of estimation methodology assessed the relative advantages and disadvantages of cross-section analysis, pooled cross-section analysis and time-series analysis. Overall, it was deemed preferable to conduct statistical analysis by using time-series, both on methodological as well as policy-related grounds. In view of the evidence presented in this part of the chapter, it appears as though individual country time-series analysis presents a more robust estimation method for the purpose of explaining variations in health care expenditures in individual countries. It will also allow the derivation of policy conclusions on a country-by-country basis, which is not possible either with the use of cross-sectional or pooled cross-sectional analysis. The choice of time-series analysis over cross-sectional and pooled cross-sectional analysis is further underpinned on theoretical grounds by the lack of homogeneity among countries as well as the bias generated through the use of different conversion factors.

3.3.3 The choice of conversion factor

Some types of empirical analysis (notably cross-sectional and pooled cross-sectional) imply that all economic variables in each country must be translated into a common measure. Two main approaches have been adopted, namely the use of exchange rates to translate all types of expenditures into a common currency, and US$ Purchasing Power Parities, whereas a third – workers' earning power – exists but has not been used at all widely. However, the choice of method presents important conceptual and practical problems. In addition to the methodological problems with the type of conversion factors used, significant problems also exist in terms of identifying prices of health care goods and services in an activity (health care), that is characterised by the absence of markets, and thus subject to price distortions. These are reviewed in the following paragraphs.

3.3.3.1 The use of exchange rates

It is evident from the literature that the use of exchange rates to make health expenditures in different countries comparable raises a number of conceptual and practical problems. First, the international spread of per capita health care expenditure exaggerates the true differences in real per capita health care expenditures among different countries. This is because, even under free trade, the equilibrium set of exchange rates would only reflect the equalisation of prices of internationally traded goods. There is evidence to suggest that productivity differentials among countries are larger for tradables than for non-tradables (mainly services, including health care). The production of non-tradables is relatively more labour-intensive, and labour is relatively more abundant and relatively less expensive in low-income countries.

Thus, the relative prices of non-tradables can be expected to increase systematically with real per capita income. This price effect causes the spread of health care expenditure to be overstated by comparisons using exchange rate conversions. Thus, exchange rates do not adequately reflect relative purchasing power across countries. In addition, their use attaches little weight to non-marketed[28] commodities[29]. Therefore, international comparisons of expenditure on non-marketed commodities, which rely on exchange rates are, at best, approximations and do not reflect true consumer preferences.

Second, different exchange rate regimes have considerable impact on the denominated variables, which further affects the credibility of the analysis conducted on this basis. Exchange rates are an economic policy tool used to influence capital movements or/and a country's overall competitiveness. It holds, for example, that under a flexible exchange rate regime, a consistent balance of payments deficit will force a national government to allow its exchange rate to depreciate, by a reduction in interest rates, for example, in order that its competitiveness be improved. Such a depreciation will make domestic goods cheaper in international markets and imports more expensive at home. In terms of health expenditures, those in a depreciating country will be understated, whereas those in an appreciating country will be overstated. Of course, this type of policy, whereby a country allows its exchange rate to depreciate in order to improve its competitiveness, may result in a series of competitive devaluations as countries whose trade interests are affected follow suit in order to restore their previous competitiveness. This is the infamous "beggar thy neighbour" policy, which may lead to considerable instability in international markets. It follows therefore that flexible

28 Namely commodities for which a "market" in which supply and demand determine price and in that sense the market clears, does not exist. Commodities, which are often described as public goods (such as education, defense and health) present such features.

29 Non-marketed commodities (goods or services) are different from non-tradable commodities (goods or services). Non-marketed commodities are those for which price is not determined through supply and demand

exchange rates are susceptible to considerable volatility and uncertainty. Fixed exchange rates, on the other hand, are only a partial solution, as the currencies covered by a particular regime are limited. This was the case of the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS), whereby most of the European currencies were tied to a fixed, but adjustable, exchange rate, whereas other major international currencies such as the Japanese Yen or the US dollar were following a flexible exchange rate regime. In addition, the reality of frequent realignments (devaluations or revaluations) within the mechanism, meant that even within the ERM, structural breaks are introduced into the data, which affect the conclusions of such analysis.

3.3.3.2 The use of Purchasing Power Parities (PPPs)

PPPs are calculated on the basis of a basket of goods that is theoretically common to all countries and which is used as a benchmark. They are calculated at 5-yearly intervals by the OECD. Specifically, the OECD GDP-PPP statistics are based on a set of 2,500 individual consumer goods and services available in each of the 29 most industrialised nations – the members of the OECD - with the cost of purchasing that specific market basket of goods and services measured in the local currency of each of those nations. For example, if the total cost of that market basket was US$100,000 in the United States and UK£75,000 in the United Kingdom, then the PPP exchange rate would be 0.75 UK pounds per US dollar. Using an over-simplified example, if UK health expenditure per capita averages £75, the cost of the equivalent real resources foregone in the UK to purchase health care would be $100 in the United States.

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forces *within* a given market territory. Non-tradable commodities are those, which are not traded *across* countries, partly because of the "non-market" nature.

As international price deflators, PPPs have none of the problems of exchange rates. International comparisons based upon them have significant conceptual advantages, including representativeness and good coverage, though their use presents a number of measurement problems, including the actual method of calculation. Such problems are compounded when the commodity groups under scrutiny are not marketed goods or services, as in the case of health care. The composition of the basket, although theoretically common to all countries, does not account for the different values and preferences that individuals in different countries attach to different components. Nor does it account for differences in the composition of the basket, which may be significant for components such as health care.

Thus, for instance, the OECD-defined "basket" for health care goods and services contains 294 items and their prices (health goods and services); pharmaceuticals account for 228 of those prices (or 77.55% of the sample) (OECD, 1990) although they account for a much smaller proportion of total health care expenditure. Within the European Union, for the 1995 Health-PPPs, EUROSTAT used the same internationally acknowledged methods to compile around 875 prices in the health sector. Of these around 800 prices (91.43% of the sample) were of pharmaceutical products and 45 were other products (medical appliances). Only 30 prices of health care services were collected. This has resulted in a significant over-representation of pharmaceutical prices in the basket of goods and services. A selection of the prices of health care services and medical goods are shown in Table **3.1**. Within EU countries services by hospitals and practising medical personnel amount to more than two thirds of total spending in health care. In principle great attention is made to select representative samples, however, this process breaks down for several reasons:

(a) There are more than 450 products in case-mix management tools, such as DRGs for acute care; as it is not possible to include all 450 products in a representative index, this suggests that a selection of homogeneous medical and surgical procedures might be desirable (also across countries);

(b) Within the 30 defined health care services, four of these concern general practitioner visits (see table 3.1). The guidelines concerning the four prices of general practitioner services are not very precise about what is to be included in the price and what excluded. To avoid different ways of reporting by member countries, the descriptions need to be much more precise, although this may then fall foul of real differences in the nature of the services provided[30].

(c) As shown in table 3.1, the definition of Eurostat PPPs also relies on 5 different types of dental service. One question that might arise from this is why prices are collected covering five different dental services, whereas all practising specialists are covered by only two services (ophthalmology and internist). Why is it, for instance, that no prices of ambulatory surgery are collected?

(d) Finally, health care is more than discrete procedures, which effectively implies that elements of chronic care should also be considered for inclusion into a representative basket of health care goods and services.

Thus, if Health PPPs are to be used, it appears that a much greater clarification of definitions (except for dentist's services, perhaps) and sampling are required. This would permit the current huge weighting of pharmaceutical products (91.43%) of the health-related PPP basket to be revisited in order to strike a more reasonable balance, between health care goods and services.

Caution should therefore be exercised in the use of Health-PPPs because health care inputs are assessed by a small sample of prices using weakly comparable volume indices, with a

30 Which further implies that robust comparison would first require standardization across countries.

bias towards pharmaceuticals. Finally, the use of 5-yearly Health-PPPs produces a blunt tool to analyse year-to-year variation.

Table 3-1 Eurostat guidelines concerning the collation of prices of health care services (PPP statistics in the EU – Prices of health services and health (non-pharmaceutical) products for the 1995 PPP exercise)

1. Primary Health Care Services

1.1. **General Practitioner**: consultation at surgery with appointment (not first consultation) without special examination but with prescription (during the day). Price for a health service patient.

1.2. **General Practitioner**: The same as 1.1. Price for a private patient.

1.3. **General Practitioner**: Home visit (workday, not urgent or night visit), including the doctors' travelling expenses for a distance of 5 km. Price for a health service patient.

1.4. **General Practitioner**: As in 1.3. Price for a private patient.

1.5. **Specialist (ophthalmologist):** Consultation at surgery with appointment; one consultation without special examination but with prescription for glasses. Price for a health service patient.

1.6. **Specialist (ophthalmologist):** As in 1.5. Price for a private patient.

1.7. **Internist**: Reading of a standard electrocardiogram (not an ECG made under varying strain) on request of a general practitioner or another specialist (not being a cardiologist, internist or paediatrician). Price for reading the ECG and for making a written report. Price for a health service patient.

1.8. **Internist**: As in 1.7. Price for a private patient.

1.9. **Dentist**: extraction of a single-root tooth without complication, including local anaesthetic by injection, excluding the charge of any radiograph. Price for a health service patient.

1.10. **Dentist**: As in 19.9. Price for a private patient.

1.11. **Dentist**: filling of molar tooth (under right 7), silver amalgam central filling (occlusal surface) without local anaesthetic. Price for a health service patient.

1.12. **Dentist**: As in 1.11. Price for a private patient.

1.13. **Dentist**: Insertion of a bonded gold/porcelain crown under right 1, without complication. The total treatment consists of: preparation of the tooth, making of the impressions, making of temporary appliance, and mounting of the crown. Price for a health service patient, including the costs for the technician.

1.14. **Dentist**: As in 1.13. Price for a private patient.

1.15. **Dentist**: Examination (check-up), normal scaling and polishing, no other treatment. Price for a health service patient.

1.16. **Dentist**: As in 1.15. Price for a private patient.

1.17. **Dentist**: Insertion of a complete appliance for an adult. Appliance is made using two plaster-caps. The fee comprises all actions between the first consultation up to the mounting of the appliance and includes the follow-up care during the first two months after the mounting. Price for a health service patient, including the costs for the technician.

1.18. **Dentist**: As in 1.18. Price for a private patient.

1.19. **Nurse (home visit):** Care of an aged, handicapped patient (routine check-up of state of health, dispensing of medicines, giving instructions). Travelling distance approx. 5 km. Price including travelling expenses. Price for a health service patient.

1.20. **Nurse (home visit):** As in 1.19. Price for a private patient.

1.21. **Nurse**: Medical treatment at the office of a district nurse (or similar category of medical staff). Intramuscular injection of vitamin B12. Price to exclude the cost of the preparation. Price for a health service patient.

1.22. **Nurse**: As in 1.21. Price for a private patient.

1.23. **Physiotherapy**: Massage of shoulder and neck muscles. 10 sessions 15 minutes each (no home visits). To be converted to price per 2.5 hours. Price for a health service patient.

1.24. **Physiotherapy**: As in 1.23. Price for a private patient.
1.25. **Laboratory**: Standard blood and urine check. Blood check: count of leucocytes and blood group, sedimentation rate, urea, creatinine blood sugar, total lipids, triglycerides, cholesterol, uracid, -GT. Urine check: albumine, glycose, sediment. Price for a health service patient.
1.26. **Laboratory**: As in 1.25. Price for a private patient.
1.27. **X-Ray-Photography**: Adult's thorax. Photo: 36x43 cm. Automatic RP (quick development). Film: Kodak, Agfa, Dupon, 3M, Hilford. Development baths of the same brand. With evidence. Price for a health service patient.
1.28. **X-Ray-Photography**: As in 1.27. Price for a private patient.

2. Hospital salaries
2.29. **Doctors**: Head of department, 15 years seniority.
2.30. **Doctors**: Doctor-assistant, not head of department, 10 years seniority.
2.31. **Doctors**: Not head of department, less than 4 years of seniority.
2.32. **Nurse**: 10 years seniority, head of department.
2.33. **Nurse**: Operating theatre nurse, 6 years of seniority.
2.34. **Nurse**: 3 years of seniority.
2.35. **Nursing-auxiliary:** 3 years of seniority.
2.36. **Physiotherapist**: 3 years of seniority.
2.37. **Laboratory assistant**: 3 years of seniority.
2.38. **Hospital administrator**: 15 years of seniority.
2.39. **Secretary (typist):** 3 years of seniority.
2.40. **Cook**: Not head of kitchen, 6 years of seniority.

3. Charges for hospital treatment
3.41. **Hospital**: Daily rate in a private hospital including the following: normal meals, medical care provided by a nurse (measurement of temperature, provision of drugs); including the daily visit of s doctor. Room for one person (no fridge or TV).
3.42. **Hospital**: Daily rate in a university hospital including the following: normal meals, medical care provided by a nurse (measurement of temperature, provision of drugs); including the daily visit of s doctor. Room for 4 persons (no fridge or TV).
3.43. **Hospital**: Daily rate in a public (non-university) hospital including the following: normal meals, medical care provided by a nurse (measurement of temperature, provision of drugs); including the daily visit of s doctor. Four-bed room.
3.44. **Hospital**: Daily rate in a public (non-university) hospital including the following: normal meals, medical care provided by a nurse (measurement of temperature, provision of drugs); including the daily visit of s doctor. Six-bed room.

Source: Eurostat, December 1992.

3.3.3.3 Workers' earning power

Given the problems encountered in the use of both exchange rates and PPPs as conversion factors, an alternative methodology has been put forward, namely the value of one hour of an average worker's time, and the volume of goods or services that this hour would purchase in different countries (Andersson, 1992). A common example is the annual estimation of how many days the average citizen has to work to pay their taxes. This measure has a number of advantages. Firstly, it is easily conceptualised, in that it would enable us to answer the question: "How long would a person have to work to pay for health services typical for their respective country? Another advantage is that exchange rate fluctuations or PPP measurement problems are no longer a problem. Table **3.2** shows some examples of the use of this methodology from a number of OECD countries.

Nevertheless, this methodology also has significant disadvantages, which hamper its use as a tool for international comparison. In particular, it has been criticised on the grounds that labour markets in different countries are subject to different regulatory regimes. Thus, assumptions that would reduce differently regulated markets to a common model may be far too simplistic. Furthermore, definitions, economies and labour forces in different countries vary quite considerably. These add considerably to the variability of the comparisons. Although standardised data on employee compensation in 26 industrialised countries are available and have been published in the past, this methodology would require a considerable amount of effort for data to become available over time and for all countries involved (US Dept of Labour, 1991).

Table 3-2 Annual Pharmaceutical Expenditures compared with Worker's Earning Power in the late 1980s (values in local currencies)

Country	currency	Per capita expenditure in national currency	Average earning per hour nat. cur.	Work hours needed to cover annual per capita expenditures
USA[1]	US$	210	14.83	14.2
Canada[4]	CAN$	217	15.86	13.7
Japan[3]	Y	37,330	1,641.00	22.7
UK[2]	£	58	6.37	9.1
Germany[3]	DM	628	31.70	19.8
France[1]	FF	1,699	83.09	20.4
Italy[1]	ITL	338,266	19,518.00	17.3
Sweden[2]	SKR	1,006	113.11	8.9
Switzerland[3]	SF	386	26.33	14.7
Greece[2]	DRA	11,015	892.00	12.3
Portugal[1]	ESC	5,468	311.22	17.6
Average		-	-	15.5

Notes: [1] 1990 value.
[2] 1989 value.
[3] 1988 value.
[4] 1987 value.

Sources: OECD (1991); US Department of Labour (1991), quoted by Andersson F., *The US Pharmaceutical Expenditures in an International and National Perspective*, Battelle, London, 1992.

3.3.3.4 A final remark on conversion factors

This part of the chapter revealed considerable methodological flaws in the use of exchange rates, purchasing power parities and average wage earnings and questioned whether the use of such conversion methods is at all necessary. As shown in the previous sections, the debate around the appropriateness of conversion measures such as exchange rates and PPPs has been quite intense [Parkin et al, (1987); Murillo et al, (1993); Saez et al, (1994); Gerdtham & Joensson (1991a); Gerdtham and Jönsson (1991b); Murthy, (1992); Gerdtham and Joensson, (1992); Kravis, Heston and Summers, (1978); Milne and Molana, (1991), Karatzas, (1992), and Hitiris and Posnett, (1992)]. It seems that, on methodological grounds, the use of PPPs has prevailed due to their ability to evaluate better the true volume of health care expenditure and income (Kramers, Heston and Summers, 1978). Consequently, PPPs are considered to be the most appropriate method to measure variations in income and expenditure across countries. However, the choice of denominator has been found to alter the extent to which health care is a luxury good or a necessity (Parkin et al 1987; Newhouse, 1977; McGuire et al, 1993; Newhouse, 1993). For instance it has been shown that the use of PPPs as deflators causes the income elasticity to drop below unity, compared with when exchange rates are used (Parkin et al, 1987). In all cases the use of PPPs reduces the extent of inter-country variation. Other results contradict this (Gerdtham and Jönsson, 1992) and suggest that the use of exchange rates to convert health care expenditure in various countries into a common currency exaggerates the discrepancies between real health care expenditure in those countries.

Consequently, this part of the chapter also took the opportunity to investigate the representativeness, coverage and validity of PPPs and found that Health-PPPs are particularly vulnerable to methodological problems, first because they are heavily biased towards pharmaceuticals and second, because the rest of the sample comprising prices of health services and non-pharmaceutical goods is not representative of health care overall. The proposal to undertake a country-by-country time series analysis effectively eliminates these problems and the methodological concerns associated with the various conversion indices.

3.3.4 The use of Health Prices and Price Indices

3.3.4.1 Availability of Health Prices

Health price indices are often used to compare price trends in the health sector with price trends in the economy in general (the latter measured, for instance, through the Consumer Price Index (CPI), or the GDP deflator). When price indices are used it is important to be aware of the problems that may arise when they are calculated over a long time period. Improvements in the quality of products or interventions included in a price index basket often go unmeasured, while the nominal price increases will often be captured exactly. Similarly, over a five to ten year time frame, typically used in national revisions and re-benchmarking of consumer price indices, the introduction of newer products bearing the same label but embodying improved technology or enhanced uses, may bias upward index-based price estimates. One such example is pharmaceuticals, which is characterised by cycles of innovation, each of which usually yields higher price premia to pharmaceutical manufacturers. Increases in the relative prices of new drug products have been attributed to both the general rise in inflation over time as well as to the increasing cost of drug development. Although the calculations are controversial[31], estimates of the cost of developing a new molecular compound were about US$231 million in the 1970-82 period (in 1987 prices) (DiMasi et al, 1991), compared with about US$ 1 million in the late 1950s and early 1960s (Mansfield, 1970) and US$ 54 million (at 1976 prices) for a new molecular entity developed between 1963 and 1976 (Hansen, 1979).

31 Relating, for instance, to what is R&D, should advertising expenditure be included in the calculations, how should opportunity costs of sunk capital be handled, among others.

3.3.4.2 Problems with price indices and selection

Price statistics have continuously been collected in OECD countries in order to construct different types of PPP. The methods of data collection and of calculation of indices and PPPs, as well as the breadth and representativeness of the prices collected have been refined continuously during these years. However, an area that has received less attention is the nature of price data for public and semi-public services where there is no market price. A number of problems exist in finding the appropriate prices to collect, as well as how to compute prices in a common currency (e.g. the US$ or the Euro).

The bias in favour of pharmaceutical prices identified in the previous section, (and the complete absence of prices of ambulatory surgery), may be explained by the fact that the health care sector in most OECD countries is characterized, to a large extent, by the absence of markets to determine prices. As a result, pharmaceutical product prices constitute the majority of observable market prices, despite the fact that personnel costs amount to more than two-thirds of total spending on health care (Kanavos and Mossialos, 1999). The absence of markets referred to above applies most strongly to public health, since public health cannot, by definition, be individualized. But even where markets do exist, they are incomplete because of important market failures and government intervention. Consequently many prices have to be artificial (Danish Ministry of Health, 1994), and careful selection of health price indices is required (Danish Ministry of Health, 1994)[32]. Finally, there is a conceptual problem because health care technology changes rapidly, creating difficulties in measuring quality-adjusted prices (Greenspan, 1997). In an area of such rapid technological change, decisions have to be made regarding the choice of an appropriate unit of output.

32 The selection of an overall health price index and the justification for its use are provided in chapter 5.

These problems challenge the validity of deflation indices when these are used at discrete points in time, for instance in cross-sectional analysis.

3.3.4.3 A final remark on health prices and price indices

With regard to prices, it was established that their use in a model of the determinants of health care expenditures is essential, particularly over time, in order to capture dynamic effects and technological change. Caution should, nevertheless, be exercised in the use of relevant price indices and their selection should be carefully justified. In particular, a dilemma exists about the choice of prices of health care goods and services, because of the extent to which they are representative and also the extent to which they take into account technological change. Given that considerable background work is still needed, it may be necessary to focus on specific sub-sets of prices that would provide adequate measurements of specific aspects of health care markets (e.g. the pharmaceutical health index to account for a measurement of "perceived" innovation). This would avoid the bias observed in the overall Health-PPP by accounting for the drug component of the health care sector only.

3.4 Conclusions

This chapter has focused on four main points:

- first, it has provided a critique of the absence of a theoretical framework used in existing analyses.
- Second, it has assessed the relative advantages and disadvantages of different estimation methodologies (cross-sectional, pooled cross-sectional, and time-series analysis) used in estimating the importance of different variables as determinants of health care expenditures.

- Third, it has discussed the validity of different conversion factors employed in cross-country comparison.
- And, finally, it has discussed health prices and the extent to which they have been used in the literature. A number of conclusions were drawn and these will shape the analysis that will be used in this thesis from chapter 5 onwards.

In particular, there is no existing theoretical or conceptual framework on which to base the health expenditure - income relationship; one can seek a relationship between health spending and any other macroeconomic variable and still come up with statistically significant results. The analysis that has hitherto taken place is therefore *ad hoc* and does not *per se* add to the existing pool of knowledge. Furthermore, there is very little analysis or theory of what actually determines health spending; rather, there is an *ad hoc* use of those factors which can be measured and are thus readily available for econometric analysis.

Consequently, chapter 5 of this thesis will undertake to establish such a theoretical framework, which will be tested empirically in subsequent chapters. This chapter will take into consideration the critique provided in this chapter.

With regard to the estimation methodology it is important in any econometric modelling to provide a comprehensive understanding of particular sequences. It is, however, doubtful whether this can be done in cross-sectional studies and it is questionable whether institutional developments can be reduced to a dummy variable in either cross-sectional or pooled cross-sectional analysis.

The evidence reviewed supports the use of individual country time-series analysis to address the question of the determinants of health care expenditures, on theoretical and conceptual grounds. Through time-series analysis for individual countries, it will become possible to explore the long-term relationships in the model to be defined in chapter 5. An individual country, time-series analysis will also enable policy conclusions specific for particular health systems to be drawn.

Concerning the different conversion factors, the available evidence from the international literature identifies problems in comparing health expenditures across countries. Exchange rates and PPPs (Health- and GDP-PPP) have serious disadvantages. Whereas exchange rates have been criticised widely in the literature, the use of PPPs has been widely accepted by default. However, this chapter has shown that Health-PPPs are severely biased towards pharmaceuticals whilst, at the same time, they cannot capture the extent of innovation. This leaves the health expenditure-related variables without a credible deflator over time that would produce comparable health expenditure data in different countries. Finally, the average worker's time methodology does not really offer a robust alternative, again because of problems of comparability.

It is concluded that none of the above conversion factors enables a robust comparison across countries. Given the individual country, time-series approach that has been put forward, the thesis will not use any of these conversion factors in the econometric analysis that will follow chapter 5. Rather, all financial variables will be expressed in national currency units (NCUs) deflated by the 1995 GDP deflator in each country, in order to arrive at constant prices for individual financial variables in individual countries..

A number of important conclusions were also reached with regard to the importance of prices and the relative price of health care. For instance, omission of a price variable might affect the value of the income elasticity of demand. Similarly, the relative price of health care in pooled cross-sectional and time-series analysis is a key factor as price movements are important determinants of changes in health care expenditures.

It is concluded that the empirical analysis that will follow chapter 5 will make use of price indices which capture movements in prices of health goods and services over the period under investigation, in order to enable dynamic effects as well as technological innovations to be adequately represented.

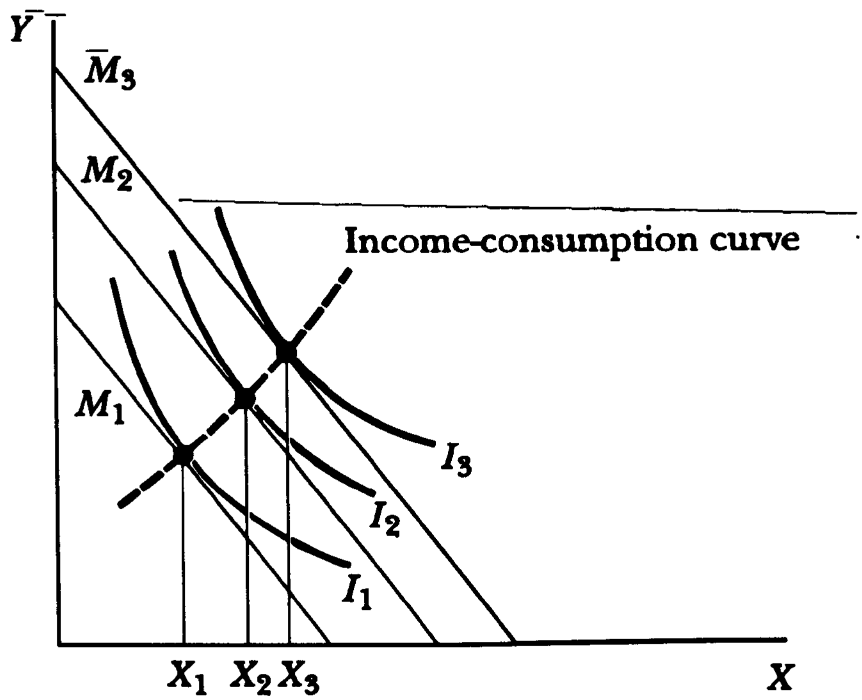
Appendix 3-1 The Engel curve: definition, derivation and link with the income elasticity of demand

The Engel curve shows the relationship between a consumer's income and the quantity of a good purchased, all other things being equal.

In order to derive the Engel curve, we need to first of all derive the income-consumption curve, in order to examine the impact of a change in income on the quantity of good X demanded. This is derived as follows. Attention is confined to two commodities by adopting the composite good convention: good *Y* represents all other goods, and good *X* is the one we are interested in. The quantity of the other goods is expressed in terms of expenditure on them.

If all prices are held constant and the consumer's budget or monetary income is increased, then the budget line (showing all possible combinations of goods *X* and *Y* that can be purchased at that income level) shifts outwards in a parallel manner as shown in figure **3.1**. The vertical intercept is now equal to the amount of the budget. So, in figure **3.1**, M_1 is the income corresponding to the lowest budget line, M_2 is a higher income corresponding to the middle budget line, and so on.

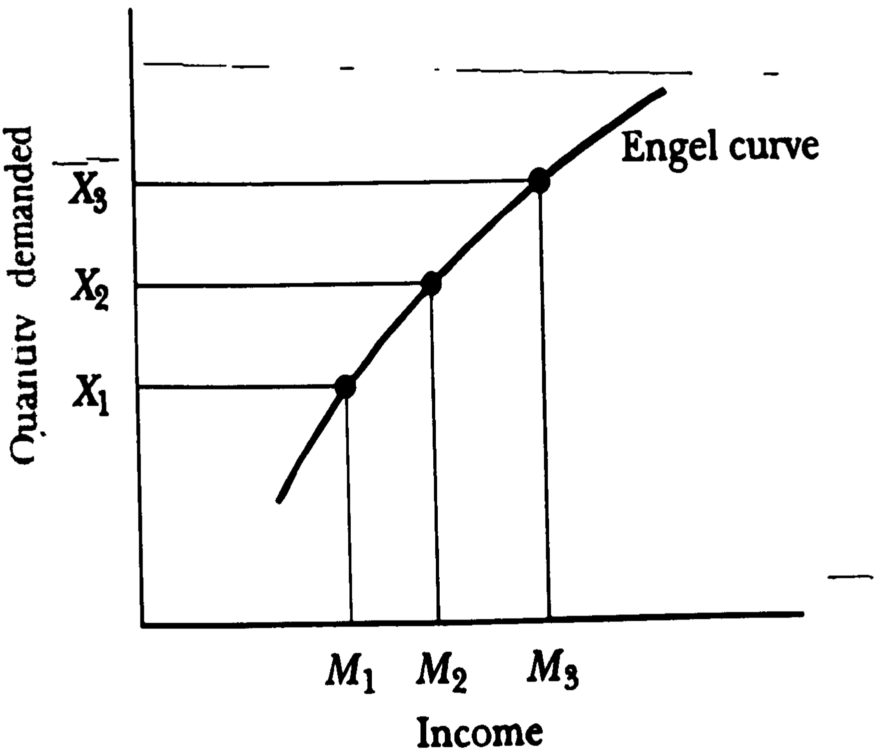
Figure 3-1 An income-consumption curve



In figure **3.1** and for each budget line, we can locate the point of tangency with an indifference curve (a curve showing combinations of two commodities that a consumer is indifferent between) and thus observe the consumer's optimal consumption bundle. By connecting all these tangency points, we derive an income-consumption curve. From the points on the income-consumption curve, we can read off the quantities of good ***X*** demanded at the different income levels.

These data can be plotted in a graph showing the quantity of good ***X*** demanded for each income level, ***M***. This graph, shown in figure **3.2**, is called the Engel curve after the statistician Engel (1821-1896), who first studied the relationship between family incomes and quantities demanded of different goods.

Figure 3-2 An Engel curve

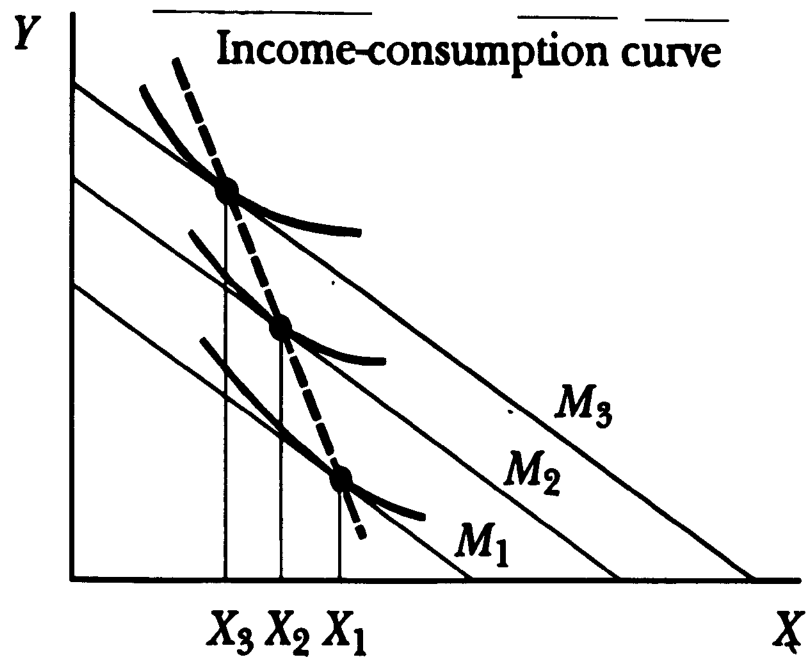


The slope of the Engel curve at any point is known as the marginal propensity to consume good X and measures for a small change (in the limiting case: an infinitesimal change) in income, the ratio of the resulting change in the consumption of the good to that change in income. We may also define the average propensity to consume the good as the ratio of the quantity of it bought at any particular level of income to that level of income, or, equivalently, given the good's price, as the proportion of income devoted to buying it. The ratio of the marginal propensity to consume the good to the average propensity to consume is defined as the income elasticity of demand for that good, and measures the proportional change in income that causes the variation, other things being equal.

The Engel curve is very often positively sloped, as in figure **3.2**, so that the quantity of the good demanded rises with income. In this case, the good is a normal good and its elasticity ranges between 0 and 1 (which also means that the marginal propensity to consume is positive, but lower than the average propensity to consume). In the case of a luxury good, the income elasticity of demand is greater than one. Such a good has a positive marginal propensity to consume, which is also greater than the average propensity to consume.

The Engel curve need not always be positively sloping, however. There are cases, where it can be negatively sloped, so that an increase in income leads to a decrease the quantity demanded. In this case, the good is an inferior good and its income elasticity of demand is negative. This implies a good for which the marginal propensity to consume is negative. Figure **3.3** shows a set of indifference curves for which the consumption of good X falls as income rises. In this case, the Engel curve is downward sloping.

Figure 3-3 Income-consumption curve for an inferior good



CHAPTER 4 METHODOLOGICAL PROBLEMS IN THE ESTIMATION OF THE DETERMINANTS OF HEALTH CARE EXPENDITURES: A WAY FORWARD - PART II

4.1 Introduction

The previous chapter focused on the theoretical framework used in empirical research of the determinants of health care expenditures, debated the robustness of different conversion factors and the selection of price indices, and discussed the rigour of different estimation methodologies. It concluded that the empirical evidence, as well as being atheoretical, had significant methodological and estimation flaws, which challenge the results obtained. It concluded by taking further the discussion on the determinants of health care expenditures, suggesting methodological steps that would lead to more robust estimates.

The purpose of this chapter is to build on this background and elaborate on four key issues in particular:

- First, to analyse methodological problems in the measurement of key variables, such as health expenditures and gross domestic product.
- Second, on the basis of the evidence presented, to explore whether there are alternative and more robust measures of a country's income (for instance, aggregate personal consumption instead of gross domestic product).
- Third, to explore certain measures of health that are commonly used in econometric analyses such as mortality, life expectancy, and ageing from a conceptual perspective and discuss the extent to which these can be used from a methodological perspective.

- And, fourth, to identify further potential determinants of health care expenditures that have not been used in the literature (for instance, technology, and the impact of other macroeconomic factors).

Thus, this chapter addresses both methodological and conceptual issues: methodological because it analyses issues of measurement of different variables and the extent to which they can be used in comparative analysis; conceptual, because it attempts to identify likely determinants of aggregate health care expenditures.

Section two investigates methodological problems related to the measurement of national health care expenditures. Section three investigates methodological problems related to the measurement and use of Gross Domestic Product, as a proxy for society's income. Section four analyses the likely impact of technology on health care expenditures and reviews how measurement of technology has been addressed in the international literature. Section five analyses the likely impact of ageing on health spending and reviews how this has been addressed in the international literature. Section six discusses other likely determinants of health care expenditures, such as the macroeconomic environment, the determinants of health, and patient expectations. Finally, section seven draws the main conclusions from the preceding sections.

4.2 Measuring Aggregate Health Care Expenditures

4.2.1 Introduction

To conduct credible international comparisons of national health care expenditures, a standardised definition of health care expenditure is needed. However, measurement of health expenditures in different countries varies considerably as several different methodologies are employed. At the same time, individual country characteristics, cultural issues, past history, and health care reforms shape the individual components of health care expenditure and their comparability across countries and over time. The following sections analyse the methodological problems in achieving comparability of health care expenditures, focusing on (i) differences in accounting systems and practices between countries, (ii) individual characteristics of health care reforms, and (iii) the role of the informal health economy.

4.2.2 Differences in measurements, and accounting systems and practices across countries

Considerable differences exist in the measurement of health care expenditures between countries due to differences in accounting systems. Within the European Union (EU), for instance, individual national statistical offices compute health expenditure figures using concepts that vary from one member country to another (Schneider, 1996). Some use the concept of final consumption of medical goods and services within the framework of Systems of National Accounts (SNA). A different approach is used by Eurostat[33] based on the European Systematic Approach of Social Protection (ESSPROS). Although this approach includes both benefits in kind and cash benefits, it differs from the System of National Accounts (SNA) in that it is primarily directed to the compilation of public transfers in the case of sickness. Finally, a mixed model with elements of both the SNA and ESSPROS is used by some national statistical services, such as the German Statistical Office. Worse still, some countries do not publish health accounts and what is available in terms of statistics, are estimates or proxies of public and private consumption in the national accounts. Examples are Belgium and Turkey.

As well as differences in accounting method followed and the resulting differences, individual countries vary as to what is included and what is not included. Consequently the reported health expenditure in one country may include components which are excluded from the same figure in other countries. Taking the USA and Japan as an example, expenditure on a normal delivery, a luxury hospital bed, and per diem nursing care is not included in Japan's definition while it is in the American definition; in contrast, expenditure on nursing homes is not included in the American definition (Tokita, 1995). Further examples are the treatment of health-related R&D spending, expenditure on social services, prison health services, and health education services, which in some countries are included in other departmental budgets, rather than in total health care expenditure which is reported by the Ministry of Health. Table **4.1** presents examples from OECD countries that reflect these problems.

Thus, studies pursuing cross-country comparisons, such as those reviewed in chapter two of the thesis, ought to have taken these issues into consideration, because with the current state of affairs such cross-country comparisons may lead to misleading results depending on which components of health expenditures are included and which are not in different countries. The compilation of data adjusted to facilitate comparisons across countries was initiated by the OECD in 1975. The development of consistent national health accounts has already required considerable efforts from many international organisations, national health, financing and statistical bureaux, but is still incomplete (Getzen, 1991).

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33 Eurostat is the statistical service of the European Union.

4.2.3 The implications of health care reforms for data collection

Often, the implementation of health care reform leads to changes in the resource allocation process, which may also lead to changes in the way(s) data are collected and reported. Such changes may also arise from changes in institutional governance. A typical example in this case is Sweden, with its three tiers of governance (central government, county councils and municipalities). County councils in Sweden are responsible for the allocation of resources for health care, on the basis of a grant received by the central government and taxes raised locally. Prior to the reforms in the early 1990s, health care in Sweden was the sole responsibility of county councils. This also included social care. A significant part of the Swedish health care reform in the early 1990s was to separate health from social care and to delegate responsibility for its delivery, along with the relevant budget, to municipalities[34].

The initial perception of this change was that Sweden's health reform policies were successful in containing costs (indeed, they appeared to reduce costs) because health spending as share of GDP fell from nearly 9% to 7.3% of GDP. However, this was largely due to the shift of costs of long-term care and home care from the health budget to the social security budget and the transfer of power from the county councils to the municipalities.

Therefore, there are two issues here: the first relates to the definition of health care expenditure, which, in the Swedish case does not include mental health, long-term care, and nursing homes, since all that is part of the social care budget; the second is associated with the administration of the different budgets (health and social care) and the role of different tiers of governance.

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34 With regards to mental health, that separation has been in place since 1985.

4.2.4 Measuring the Informal Health Economy

The informal sector[35] accounts for a significant proportion of overall economic activity in many countries (IOVE, 2001). In most countries, the scale of informal activities is among the highest in the services sector (Pavlopoulos, 1987), including health care, although, reflecting its often clandestine nature, the exact size in any country is not known. Although the size of the informal economy is thought to vary considerably, it is well known that there are substantial direct payments for medical services by individuals in many developed countries including Italy, Spain De Miguel and Guillen, 1989), Portugal, and Greece (Abel-Smith, 1994; Gardiner et al, 1995), which are not measured in figures relating to either publicly or privately provided services. Moreover, a considerable part of payments to dentists and opticians are made through either private insurance schemes or at one's own expense. A further complication is that such payments may themselves have been generated in the informal sector[36] and so be excluded from the denominator . As table **4.2** shows, it is much more likely that informal sector employees seek health care financed by their own means, since they avoid paying social security contributions. The existence of an informal sector in health services is likely to be even more widespread in developing and middle income countries, for instance in Eastern European economies in transition.

4.2.5 The way forward

On the basis of the methodological problems identified above, any cross-sectional or pooled cross-sectional analysis of the determinants of health care expenditures is almost certainly

35 Also known as informal economy, or parallel economy, or black economy. The informal sector cannot be captured by the fiscal authorities and can comprise illegal and criminal activities, such as drug trafficking and prostitution, or, indeed, legal activities the income from which are not declared to the fiscal authorities, for instance, a part-time job, or a second job in a given household, or, even, cash-only based employment.

36 This also highlights the need to look at the validity of GDP as a measure of national/individual wealth. This is done in the next section.

flawed, in that it implicitly assumes perfect comparability of health care expenditure data across countries and over time. As the previous section has shown, this is not the case. One way forward would, of course, be to standardise the measurement and reporting of health care expenditure data. However, while this might be the ideal approach, in reality, a country-by-country set of time-series analyses of the determinants of health care expenditures would partly address the issue of data comparability across countries, if it is recognised that factors affecting the distribution of the health budget overall, such as those identified above, are addressed in subsequent analysis.

4.3 Measuring Gross Domestic Product (GDP)

4.3.1 Introduction

The most widely used measure of income used in the literature of health expenditures is a country's Gross Domestic Product (GDP). There are several issues associated with the use of GDP as a key determinant of health care expenditures. The first relates to whether GDP represents an adequate and robust measure of a country's income[37]. In order to address this question, we need to consider three major issues related to the measurement and use of GDP as a determinant of health care expenditures:

37 If that question can be answered in the affirmative, then a series of other questions arise, for instance: does GDP explain variations in life expectancy across countries, in particular, the fact that some southern countries in Europe (which are, in principle, poorer) have a higher life expectancy compared with the richer northern ones (which are, in principle, richer), or should we look into lifestyle and environmental factors? A side issue relates to what extent is the comparison of current health status with current income levels valid, rather than relating past health status (and up to how many lags) to current income levels. Furthermore, does GDP explain why infant mortality in wealthy countries such as the US is higher than in other OECD countries with similar or, most frequently, lower per capita income levels (see Table 4.3), or should one be looking at other factors for an adequate explanation? Strictly speaking, however, these questions are not part of the remit for this thesis and will not be pursued further.

- First, the range of transactions captured in the estimation of GDP often varies between countries, so that data may not be comparable; while this is widely recognised, the differences identified may exceed acceptable margins of tolerance;
- Second, the scale of the informal sector (parallel economy) may have a sufficiently large impact on disposable income and its uses to bias significantly the observed relationships; and
- Third, certain transactions are not influenced by the current levels of GDP or its growth rate, but are closely linked to historical levels of wealth not necessarily associated with personal disposable income.

These factors are discussed further in the following sections.

4.3.2 Disparities in the measurement of GDP

Significant disparities emerge with regard to the definition and measurement of GDP even in economic groupings of countries, such as the OECD and the European Union, where attempts at standardisation have been in place for some time. The differences reflect how data are collected, compiled and analysed. Consequently the basis of data reporting across countries may be entirely different. Hence the results of any comparative analysis may offer misleading conclusions. A large body of literature has explored this issue in industrialised countries. The following examples highlight the problems of comparative research in using aggregate GDP measures, with particular reference to the European Union.

Analysts often refer to the European Union as a single, homogeneous entity, thereby implicitly assuming a single method of measuring national income, which would guarantee comparability of national accounts. Nevertheless, the diversity of methodologies in the collection of GDP figures and the comparability problems within the EU necessitated action by the European Commission. This action led to the Gross National Product (GNP) Directive (Commission of the European Communities, 1989), which established procedures for verification of national accounts, and, where necessary, to take action to improve the comparability, reliability and coverage of estimates of GNP[38].

The GNP Directive noted, in article 7, that special attention should be given to verifying and improving the exhaustiveness of GNP estimates, particularly the coverage of the informal economy, with this issue becoming a top priority (Commission of the European Communities, 1994). There were three aspects in particular:

- Existing calculations and adjustments already made by EU countries: it became clear that not all estimates were based on good quality data on all parts of the economy. For instance, several countries do not have good data on all services, some do not have good quality business registers, and some fail to maximise the use of the cross-checks intrinsic to the system of national accounts. Although this is expected to be improved in the near future, the disparities remain in historical data.
- Incomes in kind and tips or gratuities: the extent to which adjustments are made differs substantially between Member States. These differences reflect differences in the tax regime and regulations, in the importance of such income in the Member States, and in the interpretation of the accounting guidelines. This is an area where further work is necessary.
- Using information from fiscal audits: the need to use such information depends on the availability of other measures to combat tax evasion, and this differs for each Member

38 The adoption of the GNP Directive followed the creation of the fourth own resource of the European Communities - the GNP resource - used in the determination of the EU budget.

State and for each sector. Furthermore, while some countries can and do use fiscal audit information, to varying extents, other countries are unable to do so, either for reasons of data confidentiality, or because the non-random nature of the data makes its use statistically impossible.

Much effort has also been put into verifying the comparability, reliability and completeness of Member States' GNP estimates in a two ways: firstly, with respect to a series of issues that concern all the countries and, secondly, with respect to a large number of country-specific issues (Commission of the European Communities, 1996).

The common issues identified include:

- The definition of the boundaries of the economic territory, reflecting the transition from GDP to GNP[39];
- The recording of taxes and subsidies in each country and their comparability across countries;
- The comparability of estimates for dwelling (housing) provision;
- The comparability of estimates at the borderline between intermediate and final consumption;
- The completeness and recording of the activity of financial institutions;
- The completeness of the estimates for agriculture;
- The quality of the estimates for the transition from GDP to GNP; and
- The completeness of the estimates of VAT as a component of GNP.

39 GDP is defined as product produced by all production factors within the borders of a given country, whereas GNP is product produced within a given country, but also product produced abroad by nationals (individual or corporate) of that country.

Of the country-specific issues, which are important for GNP, the most notable improvements can be summarised as follows:

- Great efforts have been made to redevelop fundamentally the national accounts of those Member States which were seen as having the weaker basis for GNP estimates. There have already been large changes to the GNP estimates for Greece, Luxembourg and Portugal (changes in the order of +20%, +15% and +10% respectively (see table 4.4)). Similarly, important developments are under way in Belgium and Ireland, though the changes in those two countries are unlikely to be of a similar magnitude.
- All EU countries have made considerable progress in response to the Commission's country-specific reservations on aspects of their GNP compilation methods.
- All EU countries also have their own projects to develop their own national accounts. These projects are not directly the consequence of programmes emanating from the Commission, but are, nevertheless very important and complementary to the Commission's efforts.

More detailed information on the country-specific developments can be seen in table **4.5.** The impact of some of the adjustments made on estimates of GDP can be seen in table **4.4**. From this table, it appears that the revised GNP data provide a completely different picture in some EU countries, particularly those of Greece and Portugal.

4.3.3 The Informal Sector and GDP

The use of national accounts data regarding the magnitude of GDP excludes important elements, most notably the scale of the informal economy. The informal economy is by definition a non-measurable, albeit quite often sizeable, variable. As already discussed, it includes both legal (production of goods and services which will subsequently be brought onto the marketplace) and illegal, and, therefore, punishable transactions (drug dealing or trafficking). The common feature of both types of activities is that incomes generated and profits realised are not declared for tax purposes. The net result, however, is that, regardless of its legal or illegal nature, it produces income which does not necessarily remain within the informal sector's boundaries but is diffused to the benefit of the whole economy, thereby producing considerable multiplier effects.

The size of the informal sector varies by country and most efforts to measure it to date have focused on the evaluation of the "legal" informal sector. Frey & Weck Hanneman (1984) estimated the relative size of the parallel economy in 17 OECD countries using cross-sectional and time series analysis applying the LISREL software[40]. They suggested that it is around 10% of GDP in most countries (see table **4.6**), although some of the assumptions used by the authors are quite restrictive and point to much higher shares in some economies. For instance, Pavlopoulos (1987), estimated that in 1986 the informal sector in Greece accounted for over 28% of GDP. There are many other estimates of the size of the parallel economy for a number of countries and sectors (Portes et al, 1989). In Spain, for instance, 21.9% of total employment was estimated to occur in the informal sector in 1988 (see table **4.2**).

40 LISREL is a software product designed to estimate and test Structural Equation Models (SEMs). SEMs are statistical models of linear relationships among latent (unobserved) variables and manifest (observed) variables. It can also carry out exploratory and confirmatory factor analysis, as well as path analysis. LISREL uses the correlations or covariances among measured variables such as survey items to estimate or infer the values of factor loadings, variances, and errors of latent (unobserved) variables. LISREL's flexibility allows it to also estimate the relationships among latent variables with other latent variables.

Although it is generally acknowledged that estimating the exact size of the informal sector is an impossible task, its existence could be inferred from other indicators, for example the ratio of growth in property construction to GDP growth, or the ratio of bank deposits to GDP growth and so on. The size of the informal sector may also influence government policies, as the implicit acceptance of its existence may mean that certain types of expenditures are left to be taken care of by the private sector.

4.3.4 Wealth or income?

Gross Domestic Product has long been used as a proxy for national income. The question remains, however, whether GDP can actually capture adequately the notion of personal income. As well as the measurement problems noted above, even with improvements in the collection, reporting, comparability, completeness and reliability of data across countries, the measurement of GDP cannot take into account other aspects of individual income that do not constitute "product". There are two such aspects; the first is income from housing, namely imputed income from occupying one's own home, but also property ownership, which increases net household assets, and shapes expectations about total family income and family wealth. The second aspect is financial wealth, namely liquid assets including savings, bonds, government securities and shares. Both are integral parts of private non-human wealth, which, in most developed countries, considerably exceeds disposable household income, as shown in table **4.7**.

The reason why wealth is argued to be important and, perhaps, a better measure than GDP in explaining the variation in health spending, is its impact on household consumption decisions (Kanavos & Karakitsos, 1994; Hamnett & Seavers, 1996). Apart from its monetary aspects, which have consumption and investment implications, improvements in wealth have been shown to be associated with improvements in individual health status. For instance, ownership of a tangible asset (a house) contributes to individual well-being[41]. Housing and financial assets have been shown to be influential factors affecting the amplitude and the depth of the business cycle, particularly in highly leveraged (overdebted) economies, such as the UK, Sweden, Japan and the United States (Fisher, 1933; King, 1993; Hall, 1986; Kimball, 1990; Leland, 1968; Carroll, 1992; Tobin, 1980; Baumgartner and Meredith, 1995).

Consequently, private non-human wealth may be a more appropriate means of capturing the key determinants of health care expenditure. In particular, private sector wealth can capture some inherent deficiencies of GDP, which include the level of the parallel economy in a given country, as well as aspects of disposable income, such as the level of imputed income. Both these aspects increase individual marginal propensity to consume.

4.3.5 Alternative measures and way(s) forward

The use of GDP does not address some fundamental issues related to the supply of and demand for health services. For instance, GDP does not account for the supply of hospitals and doctors, and is certainly too crude a measure to incorporate an economy's ability to produce and consume pharmaceuticals or to encompass advances in technology in its health care production function. In addition, the use of GDP as the single most important variable in the determination of health care expenditure denies differences in society's willingness to pay for health care. Thus, the use of GDP could only serve to facilitate our understanding of the impact of macroeconomic factors on the growth in health expenditures. The macroeconomic

41 Provided it is either owned outright without mortgage repayment requirements, or that such requirements can

environment affects decisions in the health care sector just as it does in other sectors of the economy, particularly in countries having tax financed or social insurance-based systems. Macroeconomic pressures, stemming from the impact of an oncoming recession, or, even, a stabilisation plan, will put pressure on health spending. In countries where substantial private financing of health services exists, the advent of economic recession will trigger an adjustment process, whereby the total burden on private sector companies (the payers of private health care plans) will be reduced through layoffs or voluntary redundancies.

Consequently, the use of GDP is problematic for methodological as well as conceptual reasons. Because of measurement and reporting problems, its use in cross-sectional and pooled cross-sectional analysis is problematic so its use as a means of capturing the macroeconomic environment can only be justified in individual country time-series analysis. This means that more robust alternatives to capture adequately the impact of the macro-economy are needed. Wealth could be such an alternative, but would be extremely difficult to measure consistently over time because of the magnitude and volatility of its components (personal disposable income, imputed income from home-ownership, wealth from home-ownership, and financial wealth comprising savings, stocks, bonds and other financial instruments). However, personal wealth could be proxied by total private consumption © on goods and services[42].

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be serviced without difficulties.

42 Another significant factor that may also influence a government's position on health care spending is the amplitude and the severity of the business cycle. This can be measured either through intertemporal variations in the overall fiscal deficit or through changes in total public spending (G). Of course, once again, country-specific structural factors would influence government spending and thus, the size of the deficit and decisions to consume, so any analysis incorporating public deficit, or total public consumption or, indeed, total private consumption, would have to be in an individual country context.

Total private consumption on goods and services as a proxy for wealth captures society's willingness to pay for goods and services in general at different points in time, including a recession, and is a predictor of household or economy-wide expectations about the future. It has been shown, for example, that in the 1989 – 1992 recession in the UK, the consumption of individuals with mortgages fell by 2%, whereas those without a mortgage rose by 4%[43], an observation that emphasizes the importance of wealth rather than income. At the other end of the spectrum, the fiscal deficit is a measure of macroeconomic pressures in any given economy. A high government deficit implies that restrictions may sooner or later be imposed on aspects of government spending including health. A period of low deficit, on the other hand, does not necessitate interventions in spending. This was an important issue for most Member States of the European Union, as they strived to meet the Maastricht convergence criteria that would lead to the introduction of the single European currency. As most EU economies were initially well away from meeting the Maastricht convergence criteria[44] (see table **4.8**), additional cost containment measures, or structural reforms to increase efficiency and keep costs stable were introduced in health care (as well as in other publicly funded welfare services), regardless of the level of income within countries and regardless of the growth rates of GDP. Such measures continue to be required following the introduction of the single currency in order to ensure price and fiscal stability within the current (2002) regime pursued in the Euro-zone.

4.4 Measuring the impact of Health Care Technology

43 This is according to the Family Expenditure Survey (FES), which each year contains responses from around 3,000 home-owners with a mortgage and just under 2,000 without a mortgage.

44 These are a 3 per cent government deficit and a 60 per cent overall government debt levels, low inflation rates and long-run interest rate convergence. A sustainable 3% government deficit implies strict control over time on the total amount of government expenditure (G).

4.4.1 The treatment of health technology in the international literature

Health care technology is perceived to encompass all of the instruments, equipment, drugs and procedures used in health care delivery, as well as the organisations supporting delivery of such care[45] (OTA, 1978), (Johansen, 1988). Technological innovation has rendered profound changes in the delivery of health care services over the last 50 years, and has contributed substantially to lengthening life expectancy and further reducing avoidable mortality[46]. However, growth in medical technologies is considered by some to be responsible for the rapid escalation in health care costs in the developed world (Evans, 1983; Davis, 1974; Worthington, 1975; Altman and Blendon, 1979; and Moloney and Rogers, 1979; Klarman et al, 1970). Yet, increased prices are not the only factors underlying hospital cost increases. The complexity of diseases being treated and the intensity of services have been found to be the main factors underlying such cost increases in the US (Ashby and Craig, 1992). Technologies can be both cost reducing, contributing, for instance, to the reduction in the length of stay in hospitals or a reduction in specialists' costs, or cost-increasing in that they expand the scope of patients or conditions that can be treated, or the complexity of the treatment that is provided.

There are several costs associated with the adoption of new medical technologies, all of which are subject to different considerations; these types of costs are:

- The cost of acquiring the new technology; this is part of capital investment, and is considered a sunk cost in tax-based and some social insurance-based systems, but

45 Both, the World Health Organisation and the United States Office of Technology Assessment (now redundant) used the same definition.

46 Although health technology has been credited with improvements in average life expectancy, it appears that this is not the case, across all population groups. Evidence from the UK, for instance, suggests that life expectancy for the lowest social class, has hardly improved.

often needs to be recovered by the investing body in privately-funded health systems, through (high) utilisation;

- The cost of technology acquisition may be supplemented by the cost of operating the technology (Banta, 1990), in terms of the necessary skilled staff needed to use it appropriately; and
- The cost to the system once a given technology is paid for by insurance; here the issue is the appropriate utilisation of the technology and the extent to which over-utilisation occurs;

These cost considerations raise the question of whether technology actually improves outcome and for what patients, rather than simply whether it is safe or it does what it purports to do. An effective new technology can so easily replace an older and much less expensive technology for routine use when, for many conditions, the outcome of using the old technology may be just as good as with the new (Abel-Smith, 1996).

4.4.2 Impact of technology on health care expenditure

4.4.2.1 Theories of the impact of technology on health care costs

Although many studies argue that health technology is responsible for the escalation of health care costs over time, (among them Evans, 1983; Davis, 1974; Worthington, 1975; Altman and Blendon, 1979; and Moloney and Rogers, 1979), little is actually known about the precise impact of health technology on health care costs. In particular, the literature has focused mainly on microeconomic studies investigating the impact of specific health technologies in tightly controlled environments. Many studies evaluate the cost effectiveness of particular health technologies, with a view to making decisions about reimbursement on the basis of incremental cost effectiveness[47]. In addition, several studies explore the impact of technology on health care costs indirectly, rather than directly.

More often, technology has been treated as *a residual* (Klarman, Rice and Cooper, 1970), (Fuchs, 1972) or at the micro level, looking at the impact on growth in hospital costs because of increases in *service intensity* (Freeland and Schendler, 1983). A distinction has also been drawn between "big-ticket" or "small-ticket"[48] technology and different approaches have been used to account for the intensity in its use, among them the *excess inflation approach* (Altman and Blendon, 1979; Moloney and Rogers, 1979) and the *cost of treatment approach* (Scitovsky and McCall, 1976; Scitovsky, 1985; Showstack, 1982).

4.4.2.2 The residual approach

According to the residual approach, technology is treated as a residual in a model that analyses the determinants of health care expenditures. Fuchs (1972) used this approach to estimate a model of the determinants of health care expenditures over the 1947-1967 period, with a view to establishing the impact of health care technology. He found that growth in health care spending was positively related to population growth, rise in prices, growth in real income, and was negatively associated with declines in demand due to price increases. The residual of this model (or most of it) was labelled as the impact of technology on health care costs and in Fuchs' case it was found to be positively related to increases in health care expenditure. Mushkin and Ladenfeld (1979) repeated Fuchs' exercise by adding another variable, the relative ageing of the population, which was found to be positively related to

47 Namely to determine whether the additional cost that needs to be paid by health insurance justifies the additional benefit accruing by the use of the technology.

48 Big-ticket is a term applying to large scale, costly technologies, such as CT or MRI scanners, whereas the term small-ticket applies to small-scale technologies, such as laboratory equipment.

changes in health care expenditure. The resulting residual from this exercise was negatively related to health expenditure and that may have been due to the fact that the interaction between the different variables after the addition of population ageing would possibly include the effect of technology. The different signs and magnitude of the residual terms, however, suggest that the residual approach is flawed: as a minimum the initial model must be correctly specified if the residual term is to be interpreted as the impact of technology.

4.4.2.3 The "big-ticket" v. "small-ticket" approach

The literature is divided on the division of health care technologies into "big-ticket" and "small-ticket". Some studies found that the impact on expenditure of the latter was greater than the former (Altman and Blendon, 1979; Moloney and Rogers, 1979). However, others disagreed, especially those that looked at subsequent periods (Scitowski and McCall, 1976; Scitowsky, 1985; Showstack, 1982)[49]. Scitowski and McCall (1976) and Scitowski (1985) analysed at the cost of treating a number of conditions over ten year intervals. Scitowski and McCall (1976) found that the cost of treating 9 conditions out of 11 in their study increased from 1951 to 1971, and Scitowski (1985) found that the cost of treating 7 conditions out of a total 16 also increased from 1971 to 1981, despite reductions in the average length of stay for each condition. The increase in cost is explained by the large increase in laboratory tests. Table **4.9** shows the results for 3 conditions and shows the reduction in lengths of stay and the increase in laboratory tests. Altogether, these studies cover only a fraction of inpatient care, which is not surprising because of limitations on data as well as the diversity of conditions treated and technologies employed.

Additionally, there is evidence that industrialised countries vary significantly in their rates of adoption of common technologies. In particular, table **4.10** shows how such adoption patterns differ not only among countries with dissimilar income levels, but also with similar standards of living (for instance the very different number of magnetic resonance imaging (MRI) scanners in the UK, France, Germany and the US).

A further difficulty is the diversity of ways of paying for technology. In many countries technology is funded from revenue, rather than designated capital expenditure, and there are also alternative modes of financing medical equipment, for instance long-term leasing or, even, donation, making it undetectable in national statistics (Banta, 1995).

4.4.2.4 Hysteresis in the adoption of health care technology

Much of the existing empirical evidence on the determinants of health care spending assumes that all countries have the same technology, that is incorporated in their health production functions. This technology is implicitly assumed to be static if the analysis is conducted on a cross-sectional basis (Newhouse, 1987). However, as the previous section showed, there are dramatic differences in the level of technology.

Two issues are relevant here. First, there are, unavoidably, leaders and followers in the implementation of new technology in health care delivery. The latter adopt new technologies with a time lag. There is consequently hysteresis in the implementation of new technology. Second, notwithstanding the hysteresis in the adoption of new technology, the learning curve

49 Of course, there is a broader point relating to whether some "small-ticket" items represent "technology" and innovation in health care delivery, or, rather, they represent medical supplies, having an auxiliary role in the delivery of health care.

of lagging countries is usually fast so that it is absorbed rapidly into routine practice. It is implicitly assumed, however, that countries in which technological development is lagging have a predetermined and predefined path to follow, which is exactly the path that the more advanced countries in the comparisons have already achieved. This recalls the Rostow model of 'five stages of economic growth', which assumes that a developing (or less developed) country follows the same path that a currently developed nation followed some decades before (Rostow, 1965). The process of catching up thus becomes linear. This can be rejected because it implicitly (but quite clearly) suggests that there is no diffusion of innovation so that countries starting from a lower level can embody innovation more rapidly into their aggregate production functions[50].

4.4.3 The way(s) forward

The previous sections revealed the complexity of the issues associated with health care technology, its inclusion in national health production functions, and the measurement of its impact on health care costs at a particular point in time or over time and across countries. At best, the impact of technology has been treated as a residual, rather than measured explicitly, which is quite surprising, given its purported significance as an important determinant of health care expenditure. There are also some definitional issues as to what constitutes "health technology", although the definition that has been adopted (OTA, 1978; Johansen, 1988) is, in principle, all-inclusive and can be interpreted to comprise "small-ticket" items (e.g. syringes, wound care, etc).

50 Within the developing world, the issue of new technology and its adoption is even more complex and relates to the financial ability of nations to purchase such technologies. It also relates to the extent to which the appropriate manpower exists to operate them adequately.

Perhaps the most important problem associated with the measurement of the impact of health care technology on health care costs, is the measurement of the technology variable itself because expenditure on health technology is very difficult to capture accurately. Since expenditure on technology ***i,*** is the product of price ***(P)*** times volume ***(Q)***, then total expenditure on technology is the sum of all products on all technologies, as shown in equation (1) below.

$$E = \sum P_i Q_i, \quad i = 1, \ldots, n \qquad (1)$$

Data on prices and volumes of different technologies are not readily available. However there are two exceptions: first, expenditure on pharmaceuticals and its rate of change over time is available. Pharmaceutical expenditure comprises a significant proportion of expenditure on technology[51] and an ever increasing proportion of total health care costs. Second, health price indices over time are available but they are heavily biased towards what is measurable, namely prices of pharmaceutical products and prices of medical devices, or procedures using medical devices[52]. These two approximations of medical technology (namely the rate of growth in pharmaceutical expenditure and the price index for health goods) could be used to test statistically the impact of technology on health care expenditure.

4.5 Measuring health needs that must be responded to: Population Ageing and Historical Lifestyle Patterns

51 It is very difficult to quantify with precision total expenditure on health technology. However, the proportion of pharmaceutical spending on total health care expenditure is known with a small margin of error.

52 In what concerns medical devices, expenditure relates to utilization (price per procedure and number of cases performed), rather than the cost of their acquisition, which is part of the health system's capital or investment budget.

4.5.1 Ageing and health care costs

It has long been argued that people use health services more as they get older. Yet the contribution of the changing age structure to health care costs is less than clear. Empirical research into the determinants of health care expenditures has included an ageing variable, most often the share of the population aged 65 and above. Existing research has found that, although it may be statistically significant in pooled cross-section analysis (Hitiris and Posnett, 1992), the relationship breaks down in individual country times-series (Saez and Murillo, 1994) for a variety of reasons[53].

However these calculations seem over-simplistic in the light of more recent evidence suggesting that other factors may need to be considered in relation to the impact of ageing on a country's health care production function. Thus, microeconomic (household) studies have shown that approximately a fifth of health care costs are devoted to persons in their last year of life (Fuchs, 1984), regardless of their chronological age. Additional evidence from the US suggests that, contrary to common belief, the costs of those who die aged 80 or over are only about 80 per cent of the costs for those who die aged 65 to 79. Moreover, these costs were heavily concentrated in nursing home and home care costs (Scitovsky, 1988). It seems therefore that it is the "younger-old" rather than the "very old" who get expensive high-technology care. These results are confirmed by another study, which examined data on deceased members of a major sickness fund in Switzerland and found that (i) health care expenditure increases with closeness to death, (ii) for retired individuals, health care expenditure decreases with age, and (iii) low-income individuals incur lower health care expenditures than high-income individuals in the last months of life (Felder et al, 2000).

53 For example, there may be differences across countries in population structures, there may be differences in dealing with diseases afflicting the elderly, or the issue may be related to the way health and social services are

Another study from Germany has found that hospital utilisation is not increasing with life expectancy (Busse and Schwartz, 1997). A key issue, of course, in the above discussion is what is actually included in national health accounts.

From a financing or cost containment point of view the ageing factor may be more important where nursing care is included in health accounts and, by extension, in the health budget, whereas it will probably not feature as an important factor if health and social care budgets are kept separate. In the latter case, ageing will only feature in the health care budget to the extent that elderly patients have utilised health care services!

Much of the theoretical and empirical literature on ageing considers its the future impact on health care costs, by projecting population growth and changing age structure and estimating the change in resources needed to address the emerging needs at current levels of consumption. An early estimate of the impact of demographic change on the cost of the British National Health Service suggested that it would increase costs by 8.1 per cent over the twenty years from 1951/52 to 1971/72. Of this, about half would be due to population growth and the rest to the changing age structure (Abel-Smith and Titmuss, 1956). Others have estimated that demographic change in the UK will require an extra 8.25% growth in real expenditure between 1994 and 2014, which is slightly less than the growth of 10.3% in the preceding twenty years from 1974 to 1994, thus concluding that pressures arising from demography and morbidity are likely to have a modest impact in the future (Harrison et al, 1997). In a more recent exercise, the UK Treasury applied a range of alternative scenarios with regards to ageing and health in old age in order to calculate future resource needs. These

structured; in the latter case, long-term care may not be part of the health care budget. Whatever the differences, they receive little, if any, credit in the empirical literature.

scenarios ranged from slow increases in life expectancy associated with no changes in health status, to significant increases in life expectancy in future, coupled with improved health status and less time spent in ill-health (Wanless, 2002).

Fries (Fries, 1980) and Oslansky et al (Oslansky et al, 1990) have challenged much of this work, arguing that improvements in health and medical care will delay the onset of illness and disabling conditions, thus resulting in "the compression of morbidity and the rectangularisation of mortality" (Fries, 1980). Others (Manton and Tolley, 1991) have suggested that reduced mortality could increase the number of older living with disabilities or ill health and the length of time they survive disabled or ill. A further issue is the maximum attainable life expectancy, with some proposing that the US population might attain a maximum average life expectancy of 85 years, whereas others anticipate life expectancies of 95 or 100 years. Stoto and Durch (Stoto and Durch, 1993) note that forecasts of the number of people aged 85 and over in 2040 differ markedly. Some authors attribute such differences to nutrition patterns, which, in turn are also used to explain longevity in certain societies (Nagata et al, 2002; Sho, 2001). As a result, very different models of ageing process produce different results in terms of future death rates (Himes et al, 1994).

All these models are, however, susceptible to the effect noted by Wilmoth (Wilmoth, 1995), whereby the direct calculation of mortality rates is subject to excessive random fluctuation due to the small number of individuals who survive to advanced ages. Another difficulty is systematic bias due to inaccuracies in the reporting of age in population census and vital registration data.

Despite the extensive literature on this topic, it is far from clear how changing risk factors will affect future morbidity and mortality. The prevention or elimination of a number of risk factors may have large effects but there are inevitable time lags between changes in behaviour and in mortality and morbidity. A much better understanding of these lags is needed. The resulting changes in health will significantly affect consumption patterns and, thus, per capita expenditure. However, reduction of existing risks at younger ages may lead to exposure to other risks, which may in turn be less susceptible to intervention (Stoto and Durch, 1993).

Preston (1970) has estimated that the excess mortality for older males in different populations was closely linked to the per capita consumption of cigarettes. When the younger heavy-smoking female cohorts reach very old ages mortality and morbidity rates may increase. A number of exogenous factors, such as housing, may also affect the health status of the elderly population and consequently their demand for health services. Furthermore, societal changes including the increasing number of elderly people living alone, may affect the options for health care delivery, in particular the extent of informal care. These societal changes will differ among countries, reflecting different cultural contacts and may take quite different shapes in countries with similar levels of economic development.

4.5.2 Population Ageing: The way(s) forward

The overall impact of ageing on health care expenditure, both now and in the future, is not entirely clear. Additional evidence is needed both on the *current* as well as the *future* impact of ageing on spending. Of course the delivery of health care to the elderly differs dramatically among industrialised countries. Typical in this respect in the North - South European division, whereby institutional care for the elderly in the north is replaced by family care in the south. The evidence that health services are utilised more intensively in the last few months of life also seems to lead to the conclusion that what really is important is proximity to death, regardless of age. But in that case, chronological age becomes irrelevant as a determining factor. Consequently, this thesis dismisses any arbitrarily set age levels and certainly advances the view that adding "the share of the population aged 65 and above" in a statistical model will not add to our knowledge about the determinants of health care expenditure[54].

4.5.3 Lifestyle and health

The inclusion of relevant lifestyle variables in a production function is problematic because lifestyle factors, such as diet, smoking, or alcohol consumption act with variable, but, often, considerable lags. One would therefore need an extensive time series as well as a much better understanding of the determinants of disease than currently exists. Thus, empirical work attempting to correlate levels of health spending with levels of lifestyle factors is open to question. There is, nevertheless, a link between historical patterns of lifestyle and population structure (in particular, ageing) and current levels of disease, although aggregate analyses are complicated greatly by the uneven distribution of risk factors within societies.

4.6 Measuring the impact of other factors

There are several other variables that may contribute to the size of health care expenditure and its rate of growth over time. In addition to the potential impact of technology, ageing, and

54 A recent UK report (Wanless, 2002) follows the proximity to death approach in its estimation of the demographic impact. In order to account for the effect of proximity to death on acute health care costs, mortality rates were used to separate demographic projections into projections of decedents and survivors. These

income or consumption, which were dealt with in the previous sections, this section brings together a number of other issues that the empirical literature needs to address in more detail in the future. In particular, it examines the impact of the macroeconomic environment and its performance, the impact of health status on health expenditures, and the impact of (patient and consumer) expectations in shaping public policy responses.

4.6.1 The impact of macroeconomic performance on health care expenditures

Some authors (Hitiris and Posnett, 1992) and (Hitiris, 1997) have examined the statistical relationship between health care expenditures and other macroeconomic variables, in particular, government deficit, government debt and inflation, with a view to establishing whether convergence in economic performance and standards of living might lead to convergence of health expenditure standards. Both studies pooled observations across countries to test the impact of these variables on health care expenditures[55]. The approach used was, once again, *ad hoc* and not based on a clear theoretical framework. Neither was the analysis embedded in the existing literature on the determinants of health care expenditure.

There can be no doubt that, in principle, levels of government spending and levels of deficit may influence health expenditure. The overall macroeconomic environment and the business cycle might also influence the type and pace of reform in health services. It would therefore be important to take into account the impact of the macroeconomic environment, in terms of overall government spending (G), as well as in terms of the general government deficit. Decisions to initiate health care reforms often result from movements in the business cycle,

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population projections were then multiplied by activity rates for decedents and survivors separately, where this aiming to either contain costs or/and increase efficiency. These can, in theory, be examined, using a dummy variable for the year(s) during which reform was being implemented.

4.6.2 The impact of health status on health care expenditures

A corollary of the argument that health care is a luxury good is that reductions in the level of spending should be possible with little loss in effectiveness, as the additional impact on health will be marginal. However, the empirical evidence of the relationship between health expenditure and health status is extremely superficial and often ambiguous both at macroeconomic and microeconomic level.

At the macroeconomic level, early empirical research has concluded that there is no relationship between health spending and health status (Andreano, 1984), with health status measured as age-adjusted mortality. Maxwell (1981) finds a weak association between spending and health status only in the UK, in that low spending on health results in smaller diminution in infant mortality rates compared with other developed countries with higher spending rates, although the use of infant mortality as a measure of health has no obvious justification except that is easily available. In addition, some empirical studies of the determinants of health care expenditures, particularly of the pooled cross-section type, have experimented with the inclusion of a mortality variable as a potential determinant and have found a negative significant relationship between expenditures and the aggregate mortality indicator (e.g. Hitiris and Posnett, 1992).

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breakdown was available.
55 Both studies were reviewed in chapter 2.

Other studies at macroeconomic level have concluded that reductions in health care expenditures may well have some cost in terms of overall health [Wolfe (1986)]. This conclusion is reached by using health and life-style data from six countries (Germany, the Netherlands, the UK, the US, France and Sweden). By holding constant those changes in life style that have an impact upon health, (for instance, smoking, drinking, traffic accidents, occupational dangers), and adjusting for inflation and population size, health care expenditures do bear a positive relationship to health status. These conclusions are, in principle, supported by earlier findings by Cochrane et al (1978), and subsequent findings by Scheiber et al (1993), whereby, among others, GDP per capita is positively related with improvements in health status, defined as age-specific mortality rates. The latter two studies can actually support quite the opposite conclusion, such that greater health care resources lead to worse overall health. One possible explanation is that scarce resources are being channelled into health care rather than sectors such as education, where they would have a greater, albeit less immediately obvious, impact on health (McKee and Figueras, 2001). Another explanation may be that health care has a direct, and adverse effect on health, a view advanced by Illich (1976). These views have either been dismissed (Ingelfinger, 1977), or have been taken more seriously (Lavis and Stoddart, 1994; Evans, 1994), giving rise to arguments that politicians should shift expenditure from health care to sectors such as education, housing and employment (Smith, 1994). More recently, this debate has resurfaced in the work of the WHO Commission on Macroeconomics and Health (WHO, 2001).

In sum, a key issue is that there is no theoretical basis for relating overall mortality rates to expenditure, because of the role that other factors play in this respect; however, there is some justification for looking at specific causes of death, but, even here, the organisation and delivery of health care are probably as important as how much is spent on it.

Few empirical studies at the microeconomic level address the contribution of health care expenditure to overall health status. A study examining neonatal and post-neonatal mortality in Germany since reunification finds that since reunification, the two parts of Germany underwent a complex process that has led finally to convergence of parameters of infant health that are most likely to have been because of improvements in the quality in perinatal care. The study concludes, however, that "... in order to improve infant mortality in Germany, policy measures should focus on preventive rather than curative measures as the proportion of very low birthweight babies is increasing in both parts of Germany" (Nolte et al, 2000). However, another study, examining the contribution of medical care to changing life expectancy in Germany and Poland, suggests that improvements in medical care after the political transition were associated with improvements in life expectancy in East Germany and, to a lesser extent, in Poland, and that differences in the quality of medical care contribute to a persisting east-west health gap (Nolte et al, in press). A major, recently concluded analysis of avoidable mortality indicates that, in industrialised countries, improvements the effectiveness or quality of medical care still offers a greater potential to reduce mortality differences than has been assumed so far" (Nolte and McKee, in press).

This evidence indicates the limits of the available evidence relating economic studies involving health outcomes and health expenditures, other than the use of such outcome indicators not being justified. The thesis will not include infant mortality, life expectancy, or other indicators in the analysis that follows.

4.6.3 The impact of patient expectations and patient satisfaction on health care expenditures

There are different rates of satisfaction in different (European) countries with the levels of service provided by health systems. A recent EU-wide survey (Mossialos, 1997), although presenting evidence for a single year, indicates that, in general, the level of satisfaction increases as per capita spending on health rises among countries. Thus, it seems to hold that the more citizens spend on health, the happier they seem to be with their health care systems (see table **4.11**). Furthermore, there seems to be a north - south divide with Ireland and the UK falling in between.

Although this is a rather plausible result, this positive relationship breaks down dramatically in a number of cases. For instance, relatively low levels of spending can be associated with high levels of patient satisfaction and vice versa. Typical in this case are the examples of Denmark and the UK. Both countries spend per capita similar amounts on health; however 90 per cent of respondents in Denmark are at least fairly satisfied with health care provision in the country, the respective percentage in the UK was just over 48 per cent.

These findings illustrate the variation in expectations, showing what the population in given countries actually believes. These expectations will inevitably influence governments. One possible implication is that rising expectations about what a health system should cover may force governments to increase expenditure, perhaps by increasing the amount of private insurance. This has already happened in the Netherlands and Germany[56], whereas some other European governments are gradually reducing their role in the financing and provision

56 In both countries the highest income classes can opt out of statutory health insurance and can contract with a private health insurer; this represents approximately 33% and 10% of the insured population in the

of health care. This has been the case in Belgium, Denmark and Ireland (Natarajan, 1996) [57]. Such pressures on national governments may open the way for more private insurance. Rising income inequalities may also provide a stimulus, as the increasingly better off part of the population will seek private insurance rather than having to join the waiting lists.

Thus, the share of private insurance reflects current and expected pressures in European economies and very much depends on a number of parameters, including citizens' satisfaction with existing health services, regulation of private insurance markets, and incentives to consumers to shift from publicly provided forms of care towards private forms, among others (Mossialos and Thomson, 2002).

4.7 Conclusions

This chapter has reached a number of important conclusions related to the empirical analysis of the determinants of health care expenditures. *First*, it has shown that there are important methodological problems in the comparability of both health care expenditure and GDP across countries. Consequently, we do not have robust estimates of the level of health care expenditure across countries and its share of GDP.

Second, it is not self-evident that GDP adequately reflects societal disposable income. Instead, total private consumption was proposed as an indicator of income, in the sense that it incorporates knowledge about one's own wealth and expectations about its future state.

Netherlands and Germany respectively.

57 By the same token, the opposite can also be observed, whereby center-left governments enhance the role of the public sector and, by extension, have at times, abandoned neo-liberal reforms. This is certainly the case in the UK after the 1997 general election, where the Labour government abandoned in part the internal market and sought to increase expenditure on health in real terms, rather than explicitly endorse private coverage. It is also

Third, this chapter appraised the existing evidence associated with two very important issues, which have been at the forefront of policy analysis: ageing and technology. Many authors have tried to analyse the effects of population ageing as a determinant of health spending; although ageing is an important contributor to social security costs, its true value in pushing health care costs up has been disputed (Abel-Smith, 1994; Abel-Smith, 1996). With regards to ageing, the thesis has proposed that it be left out altogether as chronological age was deemed almost irrelevant as a contributor to health care (as opposed to social care) expenditures. Medical technology has very rarely appeared explicitly in empirical analysis, despite arguments that it is one of the most dynamic components of growth in health spending (OECD, 1996), perhaps because of the inadequacy of data on technology spending and utilisation. Despite the complexity of the issues surrounding technology, two potential proxies were suggested that would provide estimates of its impact on health care expenditure. The section on technology also highlighted the complete absence of "technology" considerations from the empirical (econometric) literature of the determinants of health care expenditures, despite the latter being accused to be a net contributor to increasing health care costs in industrialised countries.

Finally, the last section of the chapter attempted to identify other potential determinants of health care expenditures. In doing so, it highlighted the importance of macroeconomic factors, such as deficit and total public consumption on goods and services, but also the significance of lifestyle variables, the relevance of consumer expectations about health

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the case in France in the mid-1990s, where the Juppé government introduced an earmarked income tax in order to underwrite the financial sustainability of *securité sociale*.

services and the extent to which expectations shape demand, and the likely importance of output indicators, such as life expectancy and mortality rates.

The chapter concludes that the body of literature investigating health care expenditures has done very little to identify its determinants, highlight their dynamic implications and offer insight for policy-making.

The findings of this and the previous chapter will be used in chapter 5 in two ways: firstly, to develop a theoretical framework of analysis for the aggregate determinants of health care expenditures, and, secondly, to develop an empirical model that will subsequently be tested in chapter 6.

Table 4-1 Health Expenditure Accounting used by OECD Member States

Country	Remarks
Australia	Excludes minor amouns spent on defence force and prison medical services, education of health professionals outside health institutions & spending on school services. Institutions other than acute care hospitals, psychiatric hospitals & nursing homes, classified as welfare institutions are not included; fiscal year: July 1 - June 30
Belgium	No health accounts are published; different use of private/ public consumption in the national accounts; no R&D and education
Canada	Most expenditure for the education or training of health personnel are excluded; due to lack of data, the services of dentists are omitted as are the expenditures of the private sector for ambulance services
Denmark	Nursing homes not included
Finland	definition includes public environmental health and travel costs, other than ambulance services covered by the National Sickness Insurance; R&D excluded.
France	There is a break in the series between 1969 and 1970; the older series is based on consumption, not expenditures, estimates.
Germany	Including cash benefits, no private expenditures for nursing homes; estimates prior to 1970 refer to household expenditure and statutory health insurance only; there is no full identity between the aggregates and the components
Greece	No R&D and education; nursing homes not included
Iceland	Prior to 1972, the in-patient care outlays included investment outlays. From 1972, it has been assumed that all investment was allocated to in-patient care, thereby slightly increasing in-patient care as a small part related to ambulatory care.
Ireland	No R&D and education; includes estimates for private capital investment in health from 1975.
Italy	No R&D and education; nursing homes not included
Luxembourg	No R&D and education; nursing homes not included
Netherlands	No R&D and education; no gross capital formation is included but depreciation and interest are included as an approximation of the use of capital goods
New Zealand	grants to rest homes for elderly people are excluded; costs relating to individuals in private institutions are excluded.

Norway	From 1979 onwards, public expenditure sometimes exceeds total expenditure because transfers for medical care include items like transport aid and hotel aid for patients; these items are not included in private medical consumption but are allocated to transport services, hotel services, etc, in private consumption estimates.
Portugal	No R&D and education; nursing homes not included; expenditure estimates relate to mainland Portugal only.
Spain	No R&D and education; nursing homes not included
Sweden	From 1985, the National Accounts have modified the classification of the functions of government, shifting the responsibility of expenditure of the mentally retarded from health run by counties, to welfare and social services run by municipalities.
Switzerland	Estimates do not include administrative outlays, but include non compulsory health insurance.
Turkey	No health accounts are published. Total expenditure is an OECD estimate; expenditure financed by voluntary contributions to hospital associations, and from foreign aid is not included; total size of private sector is not measured directly and is probably underestimated.
United Kingdom	No R&D and education; expenditure on armed forces' health services, prison health services and nursing homes are excluded.

Sources: **a) Author's compilation from national statistical sources; b) OECD (1995).**

Table 4-2 Informal Sector Workers as a Percentage of the Work Force and by Professional Category in Spain

Employment Sector	Salaried workers (%)	Self-employed workers (%)	Total employment (%)
Informal sector	18.9	30.4	21.9
Formal sector	81.1	69.6	78.1
Total employment	100.0	100.0	100.0

Notes: [1] Includes workers in five categories distributed as follows: a) employed but not registered with social security (65.7%); b) employed and registered but not making payments (15.2%); c) employed for a salary but registered as self-employed (8.8%); d) self-employed and registered as salaried (5.1%); and e) employed and receiving unemployment compensation (5.2%).

Source: Ybarra, J-A., (1989).

Table 4-3 Life Expectancy, Mortality and Per Capita Income in OECD countries, 1999

Countries	Life Expectancy		Perinatal Mortality	Infant Mortality	GDP per capita US$ PPPs
	Females at birth	Males at birth			
Austria	80.9	74.7	6.6	4.9	24541
Belgium	81.1	74.8		6	24289
Denmark	78.6	73.7	8	4.7	26311
Finland	80.8	73.5	5.1	4.2	22807
France	82.2	74.6	7	4.7	22465
Germany	80.5	74.5	6.2	4.7	23616
Greece	80.5	75.3	8.9	6.7	14740
Ireland	78.5	73.2		6.2	24769
Italy	81.6	75.3	7.6	6.2	21844
Japan	84	77.2	6	3.6	24461
Luxemburg	80	73	8.1	5	39636
Netherlands	80.7	75.2	7.9	5.2	25162
Portugal	78.8	71.7	6.8	6	16433
Spain	82.4	74.9	6.3	5	18162
Sweden	81.9	76.9	5.4	3.6	21930
Switzerland	82.5	76.5	6.8	4.8	27407
U.K.	79.7	74.6	8.3	5.7	22459
USA	79.4	73.9	7.5	7.2	31935
Australia	81.5	75.9	5.8	5	25141
Canada	81.4	75.8	6.6	5.5	25428

***Source*: OECD Health Database, 2000.**

Table 4-4 Summary of the Improvements made to GNP estimates in EU Member States (1988 and 1991)

Country	Unit	1988				1991			
		Before improvements	After improvements	Total change	Reservation improvements	Before improvements	After improvements	Total change	Reservation improvements
Belgium	Bn BEF	5445	5513	1.25%	0.06%	6680	6699	0.28%	NA
Denmark	Bn DKR	695	694	-0.14%	0.11%	784	782	-0.26%	0.11%
Germany	Bn DM	2122	2108	-0.66%	NA	2826	2882	1.98%	0.85%
Greece	Bn DRA	7390	8997	21.75%	20.7%	12813	15726	22.73%	20.7%
Spain	Bn PTA	39190	40018	2.11%	0.69%	54223	54736	0.95%	0.67%
France	Bn FF	5645	5726	1.43%	0.07%	6722	6735	0.19%	-0.06%
Ireland	Bn IR£	18.8	20	6.38%	3.67%	24.25	25.4	4.74%	3.51%
Italy	Trn LIT	1072	1084	1.12%	-0.04%	1407	1409	0.14%	NA
Luxembourg	Bn LFR	326	360	10.43%	9.2%	433	482	11.32%	8.78%
Netherlands	Bn DFL	449	454	1.11%	1.56%	543	542	-0.18%	-0.18%
Portugal	Bn ESC	5880	6780	15.31%	15.53%	10206	10915	6.95%	10.74%
UK	Bn UK£	463	459	-0.86%	-0.1%	568	566	-0.35%	-0.25%

Source: Author's compilations from the European Commission.

Table 4-5 Progress made or planned in revising the methodologies of collecting and reporting GNP data in selected European Union Member States

Country	Improvements planned	Improvements made
Belgium	Makes a large number of detailed implicit and explicit adjustments for exhaustiveness; despite these, the lack of good quality and up-to-date basic statistics for many parts of the Belgian economy means that the estimates of GNP even after adjustment cannot be confirmed as necessarily exhaustive	A series of institutional changes have been made with the intention of giving a new impetus to the development of the national accounts. The existing system, noted as having considerable shortcomings by Eurostat in a detailed report of 1992, will be subject to a major overhaul. Important new features of the national accounts system will include a new range of basic statistics from enterprises and the replacement of the 1958 OECD framework of national accounts with that of the ESA.
Denmark	Makes a range of implicit adjustments (and some explicit adjustments) to its estimates from the production approach, for example, by using functionally derived estimates for a large part of construction activity and expenditure estimates for some service activities.	Work already completed has enabled the Commission to lift one reservation specific to Denmark, and another is expected to be lifted shortly. The Commission has also been able to lift its reservation on taxes and subsidies, after some changes were made by Statistics Denmark. Work on a wide-ranging revision of the national accounts, involving the incorporation of several important new data sources, is due to be completed in mid-1997. The revision includes a number of projects which address themselves at the Commission's remaining points of reservation specific to Denmark and others which take forward the work done so far on exhaustiveness.
France	Makes sympathetic adjustments to what is in general already high quality basic data to make allowances for the absence of units, fiscal fraud and evasion including VAT fraud and hidden labour. Altogether these adjustments result in an addition to GNP of some 12%.	Improvements made to some of the component national accounts estimates have allowed the Commission to lift one of its reservations specific to France and the reservation on the transversal reservation on taxes and subsidies. Work is also in progress on the longer-term developments needed to lift the remaining reservation specific to France.

Germany	Estimates GDP on both the output and expenditure approaches, with various adjustments made during the compilation process adding some 6% to GNP, and then chooses the higher of the resulting output and expenditure estimates as the definitive figure. A further positive adjustment is then made to allow for any imcompleteness which might remain. Together these two last procedures add over 0.5% to GNP.	Estimates GNP inclusive of the new Lander of Germany were presented to the GNP Committee. A Commission report to the GNP Committee in July 1994 gave a critical appraisal of them, noting the great efforts that had been made and some areas where they can be improved in the future. The Commission reservations specific to Germany (both the old and new Lander) are being addressed, with the different pieces of work required due to be completed at various dates between now and October 1997. The transversal reservation on taxes and subsidies has been lifted for Germany.
Greece	Has undertaken a major development of its national accounts with the aim of making them more complete. The more reliable methods now used, and more complete coverage of economic activity, resulted in an increase of some 20% to the previous estimate of GNP for 1988, with similarly large increases for other years.	The national statistical office has, with aassistance from some technical experts funded by the Commission, made great improvements to its national accounts. The major revision, largely completed in 1994, featured improved methods for, for example, construction, distribution and business and personal services, and led to the previous GNP estimates increasing by over 20%. Although some further improvements are still necessary, it is clear that a very substantial increase in the comparability and reliability of the Greek national accounts has already been achieved. The information still needed by the Commission before the specific reservations for Greece can be assessed and then in due course lifted is expected to be provided by February 1996.
Ireland	Uses data from the Census of Population to adjust and supplement other data received on numbers in employment and self-employment and hence the income of these groups. A separate substantial adjustment to allow for the possible under-reporting of income by the self-employed is also made.	A number of projects arre continuing to give important improvements to the reliability of the estimates of GDP from the income approach. In addition the development of the expenditure approach and of a supply and use framework will lead to more dependable national accounts. These developments are due to be completed in 1997, when, if the

		work is successful, it should be possible to lift all of the Commission's reservations specific to Ireland.
Italy	Uses employment statistics to make systematic adjustments to its data from enterprises to allow for unreported and hidden employment and for the likely under-reporting of activity. Use is also made of indirect methods for ensuring exhaustivity such as functional estimation methods. The adjustments for irregular labour add some 8% to GDP, and those for under-reported income add around another 3%.	The existing use of employment data to give exhaustive national accounts is recognised to be a good foundation for them. Work to make the maximum use possible of family budget surveys and to build a good quality business register is underway. Once these major tasks are completed it is expected that the Commission's reservations specific to Italy should be lifted.
Luxembourg	Completed a major revision of its national accounts in 1994, making them more reliable and complete in several respects and adding some 10% to GNP. Luxembourg makes allowances for activity not captured in its basic statistcis. However, with the exception of domestic services, adjustments are not made for hidden labour or purposefully under-reported activity.	A major revision was completed during 1994, featuring improvements to many of the basic statistics particularly for services and some of the estimation methods used. The previous estimate of GNP was increased by some 10% as a result. Once full documentation is received on the revised system of national accounts, the Commission expect to be able to lift most or all of the reservations specific to Luxembourg.
Netherlands	Has a strong set of basic statistics underlying its national accounts, notably incorporating data from the VAT system and its system of labour accounts to help to ensure the exhaustiveness of its estimates. In addition explicit adjustments are made for the under-reporting of activity in a range of branches. The explicit adjustments are based mainly on data from the fiscal authorities and add about 1% to GNP.	An important revision of the national accounts, eliminating some of the relative weaknesses, was completed in 1992. A further revision, incorporating notably further improvements to exhaustiveness is underway and is due to be completed in 1999. A study has been completed in response to the only Commission reservation specific to the Netherlands and a small revision to GNP will allow the reservation to be lifted.
Portugal	Completed a major revision of its national accounts system in 1993 with the aim of making them more complete and reliable. In the new system data on the demand for products is used to add some 5% to the basic data on production, and	The main weaknesses of the national accounts system were addressed in a major revision completed in 1994. The revision saw much improved estimates of the contribution of, for example, large parts of the services industries, and led to

	comparisons with the Labour Force Survey add about 2% more. The revision itself added some 15% to GDP.	the previous estimates of GNP being increased by some 15%. Although some further improvements to the Portuguese national accounts will still be necessary, the important work completed already should shortly allow many of the Commission reservations specific to Portugal to be lifted. The remaining reservations specific to Portugal are expected to lead to further improvements to GNP in 1996, and it is hoped that those reservations can also be lifted then.
Spain	Makes valuable cross-checks between its data to ensure that they are as complete as possible, for example using employment data, and makes an explicit adjustment for unreported construction activity.	Improvements have been made to the treatment of the national lottery and of taxes and subsidies. The Commission's reservation on the Spanish national lottery estimates is being lifted. Work is underway to enable the remaining specific reservations for Spain, and the transversal reservation on taxes and subsidies, to be lifted by 1997.
UK	Has introduced a supply and use framework to improve the cross-checks between its data, and has undertaken a major redevelopment of its business register. Explicit adjustments are made for construction activity and a further general adjustment is made for exhaustiveness based on the historic under-estimation of the income approach when compared with the expenditure approach.	Work already completed has enabled the Commission to lift all four of its reservations specific to the United Kingdom estimates of GNP.

Source: Author's compilations from the European Commission.

Table 4-6 Estimates of the Relative Size of the Parallel Economy in 17 OECD countries as a % of GNP (1978)

Country	% of GNP
Sweden	13.2
Denmark	11.8
Belgium	11.5
Italy	10.5
Netherlands	9.2
Norway	9.2
France	8.7
Canada	8.6
Austria	8.6
W. Germany	8.3
USA	8.2
UK	8.1
Finland	7.6
Ireland	7.0
Spain	6.0
Switzerland	4.5
Japan	3.9

Source: Frey B. & Weck-Hanneman, *European Economic Review*, 1984.

Table 4-7 Household Net Wealth in Major OECD Countries; 1981-1993 (Net wealth expressed as a ratio of household nominal disposable income)

Country	1981	1986	1991	1992	1993
USA	4.87	4.99	5.04	4.99	4.95
Japan	5.28	6.34	7.85	7.15	na
France	5.23	6.00	6.3[1]	na	na
Italy	5.01	5.19	5.69[2]	na	na
UK	4.13	5.3	5.55	5.28	5.68
Canada	4.09	4.15	4.36	4.47	4.59

Note: [1] 1988.
[2] 1989.

Source: OECD.

Table 4-8 Convergence criteria and macroeconomic performance in EU Member States,1994 - 2000

Country	General Government Debt as % of GDP		Fiscal Deficit as % of GDP		Inflation rates		Real Long Term Interest Rates	
	1994	2000	1994	2000	1994	2000	1994	2000
Austria	65.2	63	-4.4	-3	3	2.1	-0.2*	0.3
Belgium	136	115	-5.3	-2.4	3	1.8	-0.3*	0.2
Denmark	75.6	57	-3.8	-3	1	2.7	0.3*	-0.4
Finland	59.8	59.5	-6.3	0.3	1.3	2.6	na	na
France	48.4	55	-6	-2.9	1.8	2.5	na	na
Germany	50.2	60	-2.6	-2.5	2.7	2.1	4.8	5
Greece	113	107	-11.4	-4	10.8	5	-3.5*	-0.7
Ireland	91.1	65	-2.1	-2	2.7	2.5	0.1*	-0.4
Italy	125.4	111	-9	-2.6	4.8	3	na	na
Luxembourg	5.9	7	2.2	1.2	2.4	2	na	na
Netherlands	78	60	-3.2	-2.3	2.4	2.1	na	na
Portugal	69.4	63.5	-5.7	-3	5.5	3.2	-0.3*	-0.5
Spain	63	63	-6.6	-3	4.9	3	4.5*	5
Sweden	79.3	73	-10.8	-0.5	3.1	3	na	na
United Kingdom	50.3	52	-6.8	-2.9	2.5	3.2		

***Note*:** * 1995.

Source: *Datastream.*

Table 4-9 Average length of stay and laboratory tests for appendicitis, myocardial infarction and breast cancer, 1964 – 1981

Condition	1964	1971		1981	
	Length of stay	Length of stay (days)	Laboratory tests (number)	Length of stay (days)	Laboratory tests (number)
Appendicitis	4.2	3.8	14.3	3.5	19.2
Myocardial infarction	19.7	18.8	81.3	10.6	124.8
Breast cancer	10.5	9.5	16.6	3.3	32.9

Source: Scitovsky & McCall, 1976; Scitovsky, 1985.

Table 4-10 Frequency of selected technologies in different countries, 1990 (per million population)

Country	Scanners	MRI	Lithotripters
Australia	13.7	0.6	0.4
Canada	7.0	0.7	0.4
China	0.3	0.02	0.18
France	7.2	1.2	0.7
Germany	12.2	2.3	1.7
India	0.2	0.02	0.02
Japan	55.4	6.5	2.5
Mexico	2.2	0.2	0.17
Netherlands	7.3	0.9	0.8
Sweden	10.5	1.5	1.2
UK	4.3	0.9	0.3
USA	26.8	8.4	1.4

Source: Banta D., An Approach to the Social Control of Hospital Technologies, WHO, SHS Paper No. 10, 1995.

Table 4-11 Satisfaction from health systems in the 15 EU Member States in 1996[1]; per capita expenditure on health in US$ PPPs in 1993

Country	Very satisfied	Fairly satisfied	Neither satisfied/ nor dissatisfied	Fairly dissatisfied	Very dissatisfied	Other	Per capita health spending ($ PPP)
Belgium	10.9	59.2	19.9	7.2	1.1	1.6	1601
Denmark	54.2	35.8	3.8	4.5	1.2	0.5	1296
Germany	12.8	53.2	21.4	9.8	1.1	1.7	1815
Greece	1.5	16.9	27.0	29.7	24.2	0.6	500
Spain	3.7	31.9	34.0	20.4	8.2	1.8	972
France	10.0	55.1	18.7	12.8	1.8	1.6	1835
Ireland	9.4	40.5	17.4	18.2	10.9	3.6	922
Italy	0.8	15.5	23.1	33.5	25.9	1.3	1523
Luxembourg	13.6	57.5	16.1	7.5	1.4	3.9	1993
Netherlands	14.2	58.6	8.8	13.6	3.8	1.0	1531
Austria	17.0	46.3	27.6	4.1	0.6	4.5	1777
Portugal	0.8	19.1	19.2	37.4	21.9	1.5	866
Finland	15.1	71.3	7.0	5.3	0.7	0.6	1363
Sweden	13.1	54.2	16.7	11.4	2.8	1.9	1266
UK	7.6	40.5	10.0	25.7	15.2	1.0	1213
EU-15	8.8	41.5	19.9	18.8	9.5	1.5	NA

Note: [1] The original question read: In general, would you say you are very satisfied, fairly satisfied, neither satisfied/nor dissatisfied, fairly dissatisfied or very dissatisfied with the way health care runs in (your country)? ***Source***: Adapted from Mossialos, 1997.

CHAPTER 5 TOWARDS A THEORETICAL & EMPIRICAL FRAMEWORK OF THE AGGREGATE DETERMINANTS OF HEALTH CARE EXPENDITURES

5.1 Introduction

Chapter 2 explored the theoretical foundation of research on the determinants of health expenditure internationally and synthesized empirical evidence over the past thirty years. It concluded that the existing literature is characterized by a lack of a theoretical foundation and that the commonly cited finding that GDP is the most important determinant of health care expenditures, with an income elasticity of demand greater than unity, is largely dependent on the choice of model, the conversion factor, and the period over which the analysis takes place.

Chapters 3 and 4 focused on methodological arguments related to the determinants of health care expenditures, shed new light on the comparability of data, and highlighted the flaws associated with estimation techniques, price indices and conversion factors. In particular, chapters 3 and 4 critically discussed:

- The methodological limitations of the analytical framework and the lack of policy relevance of cross-country analysis;
- The problems of the theoretical framework, as it has been applied in the literature and the assumptions on which it was based;
- The problems of conversion factors, such as exchange rates and purchasing power parities, used in comparative research;
- The constraints of cross-sectional, pooled cross-sectional and time-series analysis in producing robust estimates. The use of cross-sectional and pooled cross-sectional analysis were ruled out on methodological grounds;

- The problems with price indices and the fact that price effects have largely been ignored in empirical research;
- The lack of comparability of health care expenditures across countries and over time;
- The methodological problems associated with the measurement of GDP in different countries and the extent to which it can be used as a proxy for total personal disposable income;
- The treatment of technology in the empirical literature and alternative ways to incorporate technology as a potential determinant of health care expenditures;
- The treatment of population ageing in the empirical literature and the problems associated with the inclusion of ageing in empirical research;
- The potential explanatory power of other variables, in particular those related to the macroeconomic environment, disease burden, inputs to the health system, and organizational aspects of individual health systems.

The purpose of this chapter is to take account of the theoretical and methodological points raised in the previous chapters, create a theoretical framework of the aggregate determinants of health care expenditure and discuss ways of estimating it empirically. Section 2 develops the conceptual theoretical framework and empirical model. Section 3 presents the variables employed in the empirical model. Section 4 discusses the countries chosen for empirical analysis and the data sources, and briefly describes the estimation techniques that will be used. Section 5 briefly summarises the theoretical and empirical advances made with the current framework. Finally, section 6 draws the main conclusions.

5.2 The theoretical framework

5.2.1 Introductory remarks

As shown in chapters 2 (literature review) and 3 (particularly section 3.2), economists have tended to analyse the determinants of health care expenditures at two levels. They have looked either at the macro level, at the impact of aggregate variables on expenditure, or at the micro level at expenditure patterns of individuals or households relative to their respective needs, resources and preferences. While noting the lack of a conceptual framework, it is also apparent that little attention has been paid to the characteristics of health care systems, particularly the way financial resources are collected, pooled and allocated. Yet, system-wide dynamics arising from resource mobilization, allocation, and service delivery have an impact on spending patterns over time. A brief look at table **5.1** and appendix **5.1** highlights the heterogeneity amongst seemingly similar systems. Consequently, any conceptual framework seeking to analyse the aggregate determinants of health care expenditure needs to take into account system-wide factors in each country.

Table 5-1 Source of health care financing in selected OECD countries (percentages-year in brackets)

Country	Main sources of finance					Public spending as a % of total health spending
	Taxation	Social insurance	Voluntary health insurance	User charges	Other	
Belgium (1994)	38	36	-	17	9[1]	74
Denmark (1996)	80.7	-	1.9	17.4	-	80.7
Germany (1995)	11	64.8	7.1[2]	7.3	9.8[3]	75.8
Greece (1992)	33.3	24.1	2.1	40.4	-	57.4
Spain (1995)	59.3	15.3	7	16.3	1.7	74.6
France[4] (1994)	3.6	71.6	7[5]	16.5[6]	1.3	75.2
Ireland (1993)	68.1	7.3	8.6[7]	13.9	2.1[8]	75.4
Italy (1995)	64.6[9]	-	2.6	31.2	2.4[9]	64.6
Luxembourg (1992)	30	49.8	2	7.9	2.8	79.8
Netherlands (1996)	10	68[10]	15	7.1	-	78
Austria (1992)	24	54	7.5	14	-	78
Portugal (1995)	55.2	6	1.4	37.4	-	61.2
Finland (1994)	62.2[11]	13	2.2	20.8	1.8[12]	75.3
Sweden (1993)	69.7[13]	13.4[14]	Negligible	16.9	-	83.1
UK (1993/4)	78.8	12.3[15]	5.6[16]	3.2[17]	-	91.1
USA (1998)	44.3	-		55.7		
Switzerland (1997)	70.5			29.5		

Notes:
1 Includes premiums for voluntary health insurance, VAT and hypothecatred taxes.
2 Includes premiums of those who have joined private health insurance funds.
3 Includes accident insurance, retirement funds expenditure, direct expenditure by employees.
4 Research, training, administrative and preventive care costs not included.
5 Mutuelles.
6 Includes voluntary health insurance (VHI).
7 Includes voluntary health insurance expenditure, other non-household expenditure and private capital expenditure.
8 Includes receipts under EU regulations, i.e. European Social Fund, European Regional Fund.
9 General taxation accounts for 27.9 per cent and payroll and earmarked taxes for 36.7 per cent. "Other", are regional revenues.
10 Includes the compulsory exceptional medical expenses scheme (AWBZ), which covers the entire population for long-term care.
11 National government: 29.2 per cent; municipalities: 33 per cent.
12 Includes private insurance, direct expenditure by employers and relief funds expenditure.
13 Includes 64.2 per cent local taxes and 5.5 per cent general taxes.
14 Social insurance (payroll earmarked tax).
15 Earmarked tax (national insurance).
16 Private health insurance premiums and other private medical payments (grossed up from Family Expenditure Survey data).
17 Mainly prescription charges.

Sources: Synthesis from Mossialos & Legrand (1999), pp. 6-8; OECD Health Data Base, 2001.

5.2.2 The theoretical framework for aggregate determinants of health care expenditures

5.2.2.1 The setting

Health care markets involve, chiefly, three agents: purchasers/insurers (which can be a public sector agencies, publicly-underwritten sickness funds, or private for-profit insurance companies), providers (doctors, hospitals, other health professionals), and consumers of health care (individuals and families, e.g. the case of a child with learning disabilities).

All industrialized countries, except the USA, provide almost universal health care coverage, which is collectively funded, with a relatively small proportion financed through voluntary health insurance [58]. Collective funding is by two main methods: general taxation and social insurance. General taxation is derived from multiple sources, such as direct and indirect taxes, corporate taxes and excise duties, paid by individuals and corporate entities, which are allocated to different end uses, including health services, through the state budget. Consequently, citizens do not know how much of their taxes will be allocated to health services. With social insurance, employees and employers contribute a premium, which is income-related, to an agency (a sickness fund). Contributions from employees and employers are pooled, with additional resources from, for example, taxation in respect of non-earners. There is always some form of public accountability by the various sickness funds, although its nature varies. However, sickness funds have independent managerial responsibility for the resources raised through contributions. In some countries they can make their own decisions about contracting of services. The state also takes an interest in the macroeconomic and

58 This also holds for countries which have a relatively long history of finance through voluntary health insurance, such as Switzerland, where the ratio of public over total health spending was 70.5% in 1997, the

equity consequences of health insurance. In these circumstances, the contribution that individuals make towards health care is, in theory, more transparent, although, of course, this ignores the often considerable cross subsidy from taxation.

In both circumstances those consuming health services do not decide what they really consume for two reasons: *first*, they do not have full knowledge about the conditions they may be suffering from and, for this purpose, they delegate responsibility to agents (usually physicians) who advise them on the best course of action. This, of course, may generate a number of well-recognised problems associated with "agency" in a principal-agent relationship (Vick and Scott, 1998; Ricketts, 1987).

Second, collective financing of health services implies that the insurer or purchaser will cover all or most of the costs associated with an individual's treatment. In the case where the purchaser/insurer covers most of the cost, the remainder is paid for by the individual, either out of pocket or, through supplementary health insurance [59]. Out-of-pocket co-insurance payments may be flat payments or a percentage of the value of the service rendered, or either, but subject to an upper ceiling after which costs are covered (deductibles [60]). Exemptions from co-insurance payments are common and may be related to individual income, severity of the condition involved, or age. Often, the scale of exemptions mean that the majority of services are provided free of charge. For instance in the UK, although only a minority of

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Netherlands (70.4% in 1998) and Germany (74% in 1997). In the US, the publicly funded share of health spending was 44.2% in 1999.

59 One such case is France, where 87% of the population are either members of voluntary, supplementary insurance funds (mutuelles), or purchase private health insurance, which complements the compulsory health insurance ,and covers, to varying degrees, the charges of statutory health insurance's non-reimbursed services.

60 A deductible is a fixed sum (usually per annum or per period covered) paid by the consumer/patient, before health insurance covers any related costs incurred by the same consumer/patient. For example, a $1,000 deductible for in-patient services implies that the patient will incur the first $1,000 of treatment costs and her insurance will kick in once the $1,000 has been exceeded.

people is exempt from payment, over 83.5% of all prescriptions were free of co-payments in 1995 (Kanavos, 1999).

Consequently, issues of affordability do not, in principle, affect individual access to health care in tax-based or social insurance-based systems, although there may be services for which access to care is restricted or rationed [61] and access may be deterred by other costs of seeking care, such as those associated with transport or loss of earnings. Affordability is, however, an issue that determines access, to a much greater extent, in private insurance-based systems.

5.2.2.2 An analytical framework of public finance: bias towards excessive budgets or adaptation to changing needs?

Neoclassical economic theory has espoused a market-based model, with government taking remedial action when markets fail (Pigou, 1928; Musgrave, 1958). One cause of market failure is the existence of externalities [62]. In this context, health care is largely a public good [63]. Beyond this, the assumption has been that government, once advised on proper

61 There are, of course, policies resulting in restrictions to access and/or rationing in the use of health services. Three examples may offer insight into the types of issues arising. For instance, the hotel aspects of long-term care services (nursing homes, care homes) is subject to means-testing in several health systems. Dental care, is excluded for large segments of the population from the reimbursable package of health services in many health systems. And some very expensive medications may either be altogether excluded from cover, or be offered very selectively to those that are thought to benefit most.

62 Externalities are factors that are not included in Gross Domestic Product, but which have an effect on human welfare. There can be negative and positive externalities. Pollution is a prime example of a (negative) external cost imposed on society: national output may only be maintained by allowing a certain degree of pollution, which detracts from the quality of life. A firm will include the private costs of materials, labour and capital used in producing goods and services, but will not count the social costs of pollution involved. On the other hand, positive externalities such as the social benefits conferred by firms in training workers who become available for employment elsewhere are again not counted in national output. Similarly, in the case of health care, the benefits accruing to society from vaccination, are not measured in national output.

63 Public goods are goods and services that are provided by the state for the benefit of all or most of the population. Unlike private products, there is no direct link between the consumption of a social product and payment for it. Public goods in their pure form exhibit three technical characteristics: non-rivalness in consumption; non-excludability; and non-rejectability. Non-rivalness implies that the arrival of an extra person does not reduce the amount of a service (e.g. health, or police, or defense) available to everyone else. Nor is it

action, will proceed to carry it out (Musgrave, 1985). Recent literature emerging from the theory of public choice has addressed the ways in which fiscal decisions are made. Initially, the fiscal process was viewed in terms of an economic model of democracy (Downs, 1957; Black, 1958). Interacting in the political market, consumers (who are also voters) and politicians (entrepreneurs) combine to provide public goods so as to approximate an efficient outcome. More recently, emphasis has been placed on the defects in that process (Buchanan and Tullock, 1962; Niskanen, 1971). Defects include (a) institutional inertias, (b) rent-seeking, and (c) the power of bureaucracy. Institutional inertias (particularly public budget inertias) arise because, once in place, public programmes are very difficult to kill off because they have a constituency prepared to fight for them. Some researchers go as far as to suggest that political choice is all but ruled out (Rose & Davies, 1994). Additionally, pressure groups seeking to force government to create a new service will have something to gain of a significant kind. Their members may be prepared to spend many hours and much money lobbying for a new service or programme (rent-seeking). Finally, public bureaucrats receive several potential gains from their jobs, including salary, perquisites of the office, public reputation, power, patronage, output of the bureau, ease of making changes and ease of running the bureau. With the exception of the last two, Niskanen (1971) claims that all these possible personal gains are directly and positively linked to the size of the agency budget.

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possible to exclude the new arrival by saying that services will not be delivered until taxes or insurance premia have been paid by him (non-excludability); nor is the individual able to reject the health service, police service or defense on the grounds of excellent personal health, feeling of safety or pacifist beliefs respectively (non-rejectability). In discussing public goods, an important distinction should be noted. For a private good, the marginal cost associated with an extra unit of output and the marginal cost of an extra user are one and the same thing, for example, if it costs £100 to produce an extra hospital bed, it also costs £100 to provide for an extra patient-that-uses-the-bed. But this identity does not hold for public goods – for instance, the marginal cost of an extra hour's broadcasting is positive (an probably large), whereas the marginal cost of an extra viewer is zero. This has important implications. If a public good is provided at all, then non-excludability makes it impossible to charge for it. This is the free-rider problem and in such cases, the market will generally fail entirely. Non-rivalness implies that the marginal cost of an extra user (though not of an extra unit of output) is zero, and, therefore, the efficient price should be based not on costs, but on the value placed by each individual on an extra unit of consumption. Since this is impractical, the market is likely to produce an inefficient output. Thus, the market is either inefficient or fails altogether. If the good is to be provided at all, it will generally have to be publicly produced.

Given the above context, the traditional concern about market failure has been replaced with concern about public sector (or government) failure, which is seen as one of the major sources (if not the major) of budget growth and has led to the emergence of a new theory of fiscal crisis (Musgrave, 1980). This suggests that the political and administrative process carries an innate bias towards adoption of programmes which do not reflect the preferences of the public and which, under a more efficient procedure, would not be adopted. Based on this diagnosis, the remedy is seen as institutional change which restricts expansion. The vision of a Leviathan consuming resources insatiably has replaced that of the benevolent welfare state (Musgrave, 1981). To that end, much of the modeling of budgetary behaviour is based on the hypothesis that there is an inherent bias towards excess budgets.

However, this argument can only be sustained if the optimal level of expenditure is known. It is apparent that an "objective" (optimal) standard does not exist (Musgrave, 1969; Musgrave, 1985). Indeed, "... a realistic appraisal does not sustain the hypothesis that distortions in the fiscal process have been the primary cause of budget growth; nor does it sustain the proposition that bias must necessarily be towards excess" (Musgrave , 1985, p. 306). Fiscal reform should therefore not be derived from a premise of excess, which calls only for cost containment (Brennan and Buchanan, 1980; McKenzie, 1984), but instead should be designed to improve information and to facilitate the translation of society's preferences into policy action, thereby improving budget composition and scope, whether the result is to raise or lower the size of the budget.

Thus, empirical evidence suggests that certain countries may actually underspend in particular services financed directly out of general taxation. The UK National Health Service has for a long time faced criticism that it underspends vis-à-vis its EU counterparts and that the outcomes of care in the UK are below those in other EU countries. In particular, sustained underinvestment in staff and facilities has led to long waiting lists and rationing of services, thus violating the equity principle. These shortcomings have led to the UK Treasury's decision to increase the funding available in the NHS over the next three decades (Wanless, 2002).

To summarise the discussion so far, it can be seen that:

(a) In the majority of OECD countries health care is considered to be at least a quasi-public good; even in countries, such as the United States, where great emphasis is placed on private insurance, a substantial proportion of total health care expenditures is government financed and supports vulnerable groups, such as the elderly, the disabled, and the poor [64]

(b) In most industrialized countries, the government, or agents closely associated with the government, are responsible for making decisions on financing, allocating and spending limited resources;

(c) Governments administer a welfare state, which is benevolent in principle, often in the face of criticisms from some quarters about the management of resources;

(d) In determining the aggregate budget, the appropriate budget share may change over time, due, among other things, to demographic and technological changes, or changes in relative costs. To that end, budget growth may not result from institutional inertia, bureaucracy, or rent-seeking, but from factors endogenous to the system the budget serves.

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64 Although, admittedly, at a level which is less than desirable.

(e) Since the aggregate public sector budget reflects decisions in individual spending areas such as health, it can be assumed that the same or similar reasons prevail for the growth over time in expenditure in these spending areas.

5.2.2.3 The resource allocation process in collectively funded health systems

In collectively funded health systems, budget allocation may take one of two forms, depending on whether funding is via taxation or social insurance: either resources are allocated to individual spending departments, such as the Ministry of Health (MoH), from the central budget, or resources are pooled by a central agency and are subsequently allocated to sickness funds [65]. This is often the final stage of a process comprising the following stages: firstly, the involvement of the institutions of government in determining planned total public expenditure (in tax-based systems), or sickness fund contribution rates (premia) and level of subsidies for special classes of citizens. This decision will take account of the government's macroeconomic objectives, financing constraints and ideological perspective.

The next stage may involve a bargaining process between the Treasury/Ministry of Finance and the spending departments about the apportionment of available resources between programmes. This stage is, strictly speaking, absent in social insurance systems, although it is implicit in decisions about contribution levels. The final stage, involves the spending departments, in this case the Ministry of Health, using the allocated resources (or the resources that have been raised through taxation) to produce the (health) goods and services desired by the electorate, and which are intended to contribute to social welfare. The focus of attention of this thesis will be the third stage. Given this, the first and second stage (where they exist) are treated as exogenous to the allocation decision.

65 Although this may in itself be a simplification, as there may be a subsequent re-allocation between funds.

5.2.2.4 The theoretical model

The model described in the following sections presents the interaction between the budget holders (governments, sickness funds, central collection agency) and individuals. It builds on and extends the model suggested by Dunne and Smith (1983) and draws upon theoretical research by Smith (1980), Dunne et al (1984), and Deaton and Muellbauer (1980). It combines the government and households as maximisers of social and individual welfare respectively. As outlined in the previous section, in publicly funded health care systems, the government or sickness funds determine the level of public expenditure on health, as well as the policy on patient contributions (cost-sharing). Furthermore, by defining a package of services that is reimbursed by statutory health insurance, the government also partly determines the extent to which households contract private insurance to cover either non-reimbursed health care goods and services, or elements of cost-sharing, or, indeed, offer an alternative mode of provision to publicly funded services [66]. Total health care expenditure therefore is the sum of all agents' spending on health care goods and services, or

$$HCE = \sum Ei \qquad \textit{(5.1)}$$

where ***E*** is health care expenditure of agent ***i***, with ***i*** defined as the public sector, individuals (paying co-payments and incurring out-of-pocket expenses), and private insurers.

Government acting as maximiser of social welfare and individuals as utility maximisers

66 This particular point may be related to individual perceptions of quality and the extent to which quality is perceived to be higher in the private sector (that also includes the waiting list for specific types of care). Or it may involve an element of choice for high earning individuals. In this case, high earners may (or must) contract health insurance with a private insurer, rather than a sickness fund. This is the case in Germany and the Netherlands.

Expenditure on health services is designed to meet certain ultimate needs in society. They are intermediate goods, inputs to produce desired outputs, H_i, for instance enhance and/or extend life. The government or the para-state agency that ultimately controls the flow of funds to health care services allocates resources to health care plans. Three main methods can be envisaged for paying for health care: (a) retrospective reimbursement for expenditure incurred, (b) reimbursement for all activity based on a fixed schedule of fees using, for instance, a system of DRGs, and (c) prospective funding based on expected future expenditure, using fixed budgets (Rice and Smith, 2002). Many health care systems in Europe have formally moved away from the first and have increasingly leaned towards the third type of resource allocation mechanism (Mossialos & Legrand, 1999), although in practice overspends are often covered retrospectively. It should, however, be noted that this taxonomy represents of necessity a simplification as it relates mainly to revenue financing. Capital financing takes many diverse forms, often with little relationship to the means of paying revenue costs.

In allocating resources, the government has in theory an objective function relating to maximizing benefit for the population served. This is rarely defined explicitly but it can be inferred that it includes elements of health gain and responsiveness. This objective function **J**, can be written in terms of these outputs, H_i, as follows:

$$J = J(H_1, \ldots, H_n) \qquad (5.2)$$

Outputs are pursued together, which may imply a degree of interaction between them.

Of course, individuals also have preferences. Let us assume that each individual, out of N possible individuals in a given country, has an indirect utility function:

$$u_h = u(x_h, p, z_h) \qquad (5.3)$$

where x_h is the total per capita expenditure that is assumed to be equal to personal disposable income, p refers to prices, and z_h is a vector of individual socio-economic, cultural and demographic characteristics. These include, for example, age, gender, race, and disability, income, education, urban status, among other things. The literature on the demand for health care goods identifies several determinants and has elucidated aspects of their significance in influencing demand for health care goods (Stuart et al, 2000; Poisal et al, 2000; Start et al, 2000).

The government's objective function includes needs of individuals as outlined in equation (3) and should take them into account. Such needs are influenced by a variety of factors such as:

- The burden of disease in the population, itself a function of age, life-course experiences, etc.
- The opportunities to respond to the burden of disease, itself a function of technology, skills, etc.
- Collective expectations.

If each of these variables is denoted by $\boldsymbol{D}$, and each of the expenditure quantities is denoted by $\boldsymbol{q}$, then each output $\boldsymbol{H_i}$ in equation (1) is generated by production functions of the form:

$$\boldsymbol{H_i = H_i(q_i, D_i), \qquad i=1,\ldots,n \qquad (5.4)}$$

Equation (4) essentially means that producing better health requires resources to be expended on those in need. In doing so, those paying for health care face two constraints. The first is the availability of financed resources, which takes the form

$$\sum p_i q_i = E \qquad (5.5)$$

which is the sum of prices p_i for the various categories of health care expenditure times quantities, q_i, demanded of health goods and services. E is health care expenditure. The budget constraint is also shaped by the macroeconomic situation, the business cycle, political preferences, and may also be affected by individual expectations about the future state of the world. The second constraint is the scarcity of the inputs, such as staff, facilities or technology that the financial resources are intended to purchase.

Policy-makers would in principle wish to maximize the objective function J, that is, maximize benefit to society. Doing this may ensure that they maintain power, enhance patronage, or meet their ideological goals. The budget available to them is constrained by fiscal and monetary policy considerations [67], but also by political preferences and the macroeconomic environment in which the country operates and which affects decisions about resource allocation. They may also wish to increase J, by raising the public outputs H_i, through the use of more inputs q_i. These inputs, measured by expenditures on different health services, are composite bundles of factors, and are supplied at prices p_i, which politicians as regulators have some power to influence. This power results from the monopolistic or

67 This would be the case in both tax-based and social insurance-based systems. In tax-based systems, fiscal policy determines overall tax policy, and influences the amount of taxes accruing to the Treasury, both directly (e.g. income tax, corporation tax, etc), or indirectly (e.g. through VAT, sales taxes, excise duties, etc). The process is slightly different in social insurance-based systems, in that sickness funds and/or the government agree on the insurance premia, payable by employees in employment and employers and deducted each month by means of payroll taxation.

oligopsonistic structure of health systems, which implies that purchasers of health goods and services exert some control over their prices [68], although this control may be limited [69], particularly with regard to the implementation of new technology, due to lack of adequate information, or, simply political naivety as the case of the Czech Republic in the 1993-5 period demonstrates [70]. The politicians' problem is to maximize $\boldsymbol{J}$ subject to a budget constraint, input prices, the type of technology and households' needs. Substituting (4) into (2) the direct welfare function can be written as

$$J = U(\boldsymbol{q},\boldsymbol{D}) \qquad (5.6)$$

Where $\boldsymbol{q}$ are vectors of expenditure quantities and $\boldsymbol{D}$ are vectors of variables such as burden of disease, scope to respond, etc. Constrained maximization of this will produce a level $\boldsymbol{J^*}$ of the objective function, and the corresponding expenditure will be equal to the minimum cost necessary to reach that level, namely

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68 An integrated tax-based health care system, or a social insurance system with a single insurer is monopsonistic in nature, in that purchasing of health care goods and services is conducted by a central authority and the means of provision are strictly owned by the system or purchasing authority. In this case, the monopsony determines prices of health services, subject to individual regulatory schemes applying to specific parts of health care delivery (e.g. pharmaceuticals), which may allow (some) price flexibility. A contract system (either tax-based with a purchaser provider split, or a social insurance system with multiple insurance funds), is monopsonistic or oligopsonistic in nature. Insurance funds can negotiate prices and volumes of health care goods and services and purchase bulk at a preferred price. As in the previous case, this is subject to regulatory schemes in operation for particular services (e.g. pharmaceuticals), which apply to these services at national level (e.g. a positive list for pharmaceuticals, which is common across sickness funds, and which is negotiated nationally between manufacturers and government and sickness fund representatives. Such negotiation includes prices, or volumes, or a combination of the two).

69 Such control is depends on what is actually being purchased and whether there is a short- or a long-term view; for example, in the case of medicines, outright price control is possible in the short- as well as the long-term by the monopsony in question. With regards to the labour market, however, this relationship would only hold in the long-term only if there were free movement of labour.

70 This is when the country's leadership decided to implement reforms, such as fee-for-service payments to physicians and generous reimbursement to pharmaceuticals, which effectively contributed to the entire health budget being spent within 7 months in 1994.

$E = C(J^*, \boldsymbol{p}, \boldsymbol{D})$ (5.7)

The price derivatives of the cost function $\boldsymbol{C(J^*, p, D)}$ are the amount of each input demanded,

$q_i = g_i(J^*, p, D) = \partial C / \partial p_i$ (5.8)

and the indirect welfare function,

$J = I(E, \boldsymbol{p}, \boldsymbol{D})$ (5.9)

can be used to substitute for $\boldsymbol{J}$ to give a simple set of estimable input demand functions,

$q_i = q_i(E, \boldsymbol{p}, \boldsymbol{D})$ (5.10)

The assumption of welfare maximization or cost minimization by the government then implies restrictions on the parameters of the demand function in (10), such as homogeneity [71], symmetry [72], and negativity [73], and these are testable (Dunne and Smith, 1983). The implementation of the model requires choosing a functional form for the system of equations (10). The form used is that associated with the almost ideal demand system

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71 A homogeneous production function is such that, when each input factor is multiplied by a constant k, the constant can be completely factored out. To illustrate, if we have

q = 2x + 3y + 1.5z

If we increase all inputs by some proportion k, then:

Hq = k(2x) + k(3y) + k(1.5z) = k(2x + 3y +1.5z)

Since k can be completely factored out, that is, each term contains the same power of the proportionality factor, this production function is homogeneous. The reason why this is important, is because the degree of homogeneity provides the key to the returns to scale question (increasing – constant – or decreasing returns to scale).

72 Symmetry, as well as negativity, derive from the existence of consistent preferences. The symmetry of a consumer's substitution matrix is not easily interpreted without reference to the cost function; it is hardly intuitively obvious why, for instance, a compensated penny per pound increase in the price of apples should increase the number of bars of soap bought by a number equal to the number of more pounds of apples bought consequent on a compensated penny per bar increase in the price of soap. Nevertheless, symmetry is a guarantee of and test of the consumer's consistency of choice; without it, inconsistent choices are made.

73 Negativity comes from the concavity of the cost function, which is entirely due to the fact that costs are minimized, or equivalently, that utility is maximized.

(AIDS), (Deaton and Muellbauer, 1980). The attraction of AIDS is that it aggregates perfectly over consumers [as in equation (5.3) above], without invoking parallel linear Engel curves.

5.2.2.5 Closing comments on the theoretical model

The model developed in the previous section has its foundations in the public finance literature and public choice theory, but differs from the theoretical considerations that underpin these in that it allows a flexible adjustment mechanism. This derives from the stream of literature which suggests that the appropriate budget share may change over time. The model, therefore, allows for flexible adjustment in light of demographic and technological changes, changes in relative costs, the growth of per capita income, and the impact of the macroeconomic environment.

5.2.3 The empirical model

The reduced form of the determinants of health care expenditures on the basis of the above theoretical model is estimated by using a log-linear model. The advantage of log-linear models rests in how' the values of individual coefficients represent elasticity values, in which case we are immediately able to test the 'health care being a luxury' assumption. Aggregate health expenditures are, thus, determined by institutional and aggregated household characteristics, on the basis of maximization of an objective function, as follows:

$$\log E = \alpha_0 + \alpha_1 \log Y + \alpha_2 \log M + \alpha_3 \log \Delta T + \alpha_4 \log X_{ij} + \alpha_5 \log Z_{ij} + \varepsilon \qquad (5.11)$$

where $\boldsymbol{E}$ is total expenditure on health, $\boldsymbol{Y}$ is income in the economy, $\boldsymbol{M}$ is the impact of the macroeconomic variables, $\Delta \boldsymbol{T}$ is technological change, $\boldsymbol{X}$ refers to prices of health goods and services and $\boldsymbol{Z}$ refers to other characteristics of health systems (changes in provision, reforms, as well as inputs, such as medical personnel, etc.).

5.3 The variables

In order to test the model developed in the previous sections, a number of variables have been developed. In accordance with the methodology developed in chapters 3 and 4, all monetary variables are expressed in the national currency of each of the 13 countries identified for statistical analysis, and are subsequently deflated by the GDP deflator to represent constant 1995 values. Total health care expenditure, public health care expenditure, Gross Domestic Product, Total Private Consumption, and Total Government Spending are expressed in natural logarithms, so that the coefficients obtained represent elasticities. The period under investigation is 1960-1998. The estimation period was selected on the basis of (a) data availability and (b) uniformity among the countries involved in the analysis.

5.3.1 The dependent variable

The dependent variable used to test the model developed in the previous section is total health care expenditure. Although differences do exist among countries regarding the measurement of total health care expenditure, as discussed in chapter 3, these differences are less likely to affect single country time-series analysis. The definition of total (or national) health care expenditures is based on the following identity and functional boundaries of medical care, provided by the OECD [74]:

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74 All variable definitions are provided by the OECD; in its attempt to standardize across its member states, the organization may have applied definitions which are sub-optimal. In other cases, not all countries are capable of meeting the definitional criteria for certain variables. Attempts have been made to include countries for which the definition for each variable applies without compromise.

Total health care expenditures =		Personal health care services +
	+	Medical goods dispensed to out-patients +
	+	Services of prevention and public health +
	+	Health administration and health insurance +
	+	Investment into medical facilities

Name of variable and format: **LNHEX**, which is the log of total health care expenditure in constant 1995 prices [75].

Data sources: OECD Health Data 2000, OECD, Paris, 2000

5.3.2 The independent variables

5.3.2.1 Introduction

The theory of public choice – flexible adaptation, outlined in the previous section identified five main areas as potential determinants of health care expenditures:

(a) The macroeconomic environment and fiscal policy decisions

(b) Technology

(c) Prices

(d) Inputs to the health system

(e) Consumer demand and expectations

The variables chosen to test this model are as follows:

5.3.2.2 Macroeconomic variables

Macroeconomic variables are likely to contribute to the determination of total health care expenditures, since they signal the stance taken on fiscal and monetary policy in response to

75 To achieve this, current total health care expenditures have been deflated by the GDP deflator (1995=100).

movements in the national business cycle [76]. Although spending on welfare services such as health care is expected to be rigid downwards [77] regardless of whether there is a boom or a recession, policy-makers are almost certainly going to resist increases in health care spending, in real terms, if not also in nominal terms, during a recession. Understandably, however, there may be increased needs because of the health impact of unemployment [78]. It is therefore understandable that during a recession, governments seek to contain the rate of growth of spending, exactly because the sources of financing expenditure yield less income due to a slowdown in economic activity and to support specific groups such as the unemployed. Consequently, when seeking to cut back on public expenditure, the publicly funded health sector is a key target. Theoretically, therefore, the examination of the relationship between health expenditure and GDP should be replaced by that between the growth in GDP and growth in health expenditure over time. In addition, the total level of public debt and the current budget deficit are indicators of fiscal stance on future public policy directions regarding health. Public debt affects (health) spending in the long-term, whilst the current budget deficit is an indicator of short- to medium-term macroeconomic policy directions. In view of the above, the following macroeconomic variables have been retained.

i. Budget Deficit

Rationale: The general government budget deficit is an indicator of fiscal stability or imbalance at any given point on the business cycle. Fiscal prudence suggests that, at steady-

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76 Of course there may be regional variations in the business cycle, for instance, the north-southeast divide in the UK, but what is of interest at macro level is the national average. Furthermore, there may be differences in the movements of the business cycle at supra-national level, as is the case with the Euro-zone. Again, this thesis examines national business cycles and supranational differences will not influence the outcome of the analysis, so long as the body responsible for the conduct of fiscal policy remains at national rather than supranational level.

77 Implying that it is almost impossible to reduce, at least in nominal terms, the amount of resources allocated to health.

78 The combination of increased needs and 'steady state' requirements imply that during a recession the share of public spending on GDP increases, because GDP contracts, resulting in higher indebtedness.

state, the budget should be balanced and any fiscal deficit should be zero. Indeed, fiscal prudence as a macroeconomic policy objective is pursued with vigour and imbalances are corrected over the medium- to long-term. To the extent that health services are publicly financed or publicly underwritten, the budget deficit acts as an indicator of fiscal policy, which in the majority of cases is countercyclical, namely loose during a recession and tight in a boom. It would therefore be expected that a tightening of fiscal policy to reduce the deficit might have an impact on health care expenditure. In European Union countries, the presence of an additional constraint might exacerbate the situation: European Union Member States signing up to the single currency have had to meet tight fiscal requirements in order to qualify for inclusion in the Euro-zone in the post-1995 era.

Definition: The budget deficit is defined as the excess of net acquisitions of financial assets by transactors over their net incurrence of liabilities (the difference of total government revenue minus total government expenditure).

Name of the variable and format: Two different variables will be employed in econometric analysis: the first is **DEFICIT**, which is the per capita budget deficit, expressed in 1995 constant prices (divided for this purpose by the GDP deflator). It is not possible to construct the logarithm of this variable as on certain occasions it becomes negative (surplus). The second is **DEFPCT**, which is the deficit as a percentage of GDP.

Data sources: OECD Health Data Base, OECD, Paris, 2000; and International Financial Statistics, International Monetary Fund, various years.

Expected performance: It is expected that the size of the deficit and health care expenditure will be inversely related, such that the larger the deficit, the more stringent fiscal (and tax) policy will be and, therefore, the rate of growth of health care expenditure may be contained.

ii. Total Private Consumption

Rationale: Total final private consumption is presented as a proxy for private sector non-human wealth. Consumption rates in a given economy account not only for income from employment, but also for income generated in the informal (parallel) sector, as well as imputed income from property and other liquid financial assets. Theoretically, therefore, it is argued in this thesis that consumption is a more representative measure of private sector income as well as overall wealth (which incorporates income from employment), than GDP. This is particularly the case where other financial and non-financial measures of wealth play an important role in individual and household consumption decisions and also influence the amplitude and the depth of the business cycle. Changes in wealth, both financial and non-financial, and, by extension, falls in personal consumption levels, have been responsible for severe recessions in the UK, the US, the Scandinavian economies (with the exception of Denmark) and Japan over the past twenty years, but also in the 1930s (Kanavos & Karakitsos, 1994; King 1994; Tobin, 1969; Tobin & Brainard, 1977) (see **Appendix 5.2** for the relationship between wealth and consumption).

Definition: Total final consumption on goods and services by households in a given year.

Name of the variable and format: **LNC95**, which is the log of real total private consumption for goods and services, expressed in 1995 prices. The lag of this variable by one period (**LGLNC or LNC(-1)**) has also been used in the analysis to be consistent with the conceptual model put forward, namely that expenditure at ***t+1*** may depend on income generated at time ***t***.

Data sources: International Financial Statistics, International Monetary Fund, 1960-1998.

Expected performance: It is expected that if there is a relationship between aggregate macroeconomic variables and total health care expenditures, it will be captured by the consumption variable. In particular, it is expected that the relationship will be positive, such that an increase in total final consumption will be due to higher income from all sources, and positive perceptions about individual financial and non-financial wealth.

iii. Total Government Consumption

Rationale: Decisions about total government spending have an important influence on health spending to the extent that the latter is publicly (collectively) funded. Thus, there is an implicit relationship between government spending and health care expenditures (total or public), such that the former partly helps determine the latter.

Definition: Total outlays of central (federal), local (state, provinces, cantons, municipalities) governments and social security administrations. The outlays include the purchase of goods and services, transfer payments to households, subsidies to producers, the servicing of the public debt, and public investment.

Name of the variable and format: **DELTAG95**, which is the percentage change in total public expenditure in constant 1995 prices. As total government spending (***G***) and total health care spending (***LNHCE95***) or total public health spending (***LNPUB95***) are correlated, the **DELTAG95** is used instead. Regressing total health spending on total government spending would be spurious and would result in collinearity.

Data sources: OECD Health Data Base, OECD, Paris, 2000; and International Financial Statistics, International Monetary Fund, various years.

Expected performance: It is expected that if the change in total government expenditure has any impact on total health care expenditures this would be in the same direction. However, a decrease in overall government spending is not expected to result in decrease in health care expenditures, perhaps only in a reduction in its rate of growth.

iv. Gross Domestic Product

Rationale: Traditionally, the theoretical justification for the inclusion of GDP has been that it is a reasonably good proxy for total income in the economy and, therefore, is best placed to test the aggregate relationship between income and health care expenditures. In chapter 4 of the thesis it was disputed that GDP is a good approximation of society's total income, because of accounting, measurement, comparability and inclusiveness issues. This view is maintained here and although the estimation approach adopted in this thesis (time-series econometric analysis, on a country-by-country basis) takes away some of the accounting and comparability problems, it still does not eliminate the measurement problems. Governments, however, observe the GDP rate of growth and set spending targets based on GDP growth projections. Therefore, the only GDP-related variable included in the analysis is **DELTAGDP**, which is the year-on-year real rate of growth in a given economy.

In the analysis that follows (in chapter 6), we have also run the same models for each country, by including the log of GDP (**LNGDP**) as a measurement of income for that country. While this may appear to be contradictory to what has been said in chapter 4 about GDP as a proxy for income, it is done to serve only one purpose: to determine whether at the country level the income elasticity of demand for health care exceeds unity, and with a view to comparing the results from the empirical literature, with the results obtained by this thesis. The thesis also adopts a measure of GDP which does not include total health care expenditure, since health expenditure is a component of GDP.

Definition: Gross Domestic Product (GDP) is defined as total domestic expenditure plus exports less imports of goods and services minus health expenditure.

Data sources: OECD Health Data Base, OECD, Paris, 2000; and International Financial Statistics, International Monetary Fund, various years.

Expected performance: The inclusion of the rate of growth of GDP, will add a long-term dynamic feedback effect to the model, which has been missing from the literature so far.

5.3.2.3 Technology

Rationale: A key component of the proposed model of aggregate determinants of health care expenditures is health technology and its impact. The model suggests that the impact of technology is important and positively related to health care expenditures and their growth over time. As already pointed out, a common feature throughout the industrialised world is the rising cost of new medical technology. Although health care technology has received much attention in the literature, most attempts to measure its actual impact have failed and, as a result, it remains one of the non-estimated factors that appear in the residuals of econometric investigation, as was noted in chapter 4 of the thesis.

Definition: The consumption of pharmaceutical goods comprises prescription medicines and self-medication, often referred to as over-the-counter (OTC) products, both in in-patient and out-patient care. The series includes the pharmacists' remuneration when the latter is separate from the price of medicines. Pharmaceuticals consumed in hospitals are excluded, as these could not be captured in a representative manner in several countries. The expenditure time-series includes VAT and sales taxes where applicable; taxes, where applicable, are automatically imposed on pharmaceutical products and their effect is difficult to disaggregate once this has taken place.

Name of the variable and format: **PHRMPCT**, which is the percentage real growth rate, year-on-year, of per capita pharmaceutical expenditure in each country. Per capita pharmaceutical expenditure has been deflated and has been expressed in 1995 prices before the rate of growth was calculated. The variable is not all-inclusive and would provide a partial capture of technology costs. It is, nevertheless, the only variable that can currently approximate the issue of technology with some credibility. As we are interested in the rate of growth of pharmaceutical expenditure, any tax effects or long-term volume effects should disappear.

Data sources: OECD Health Data 2000, OECD, Paris, 2000; National Pharmaceutical Industry Associations; Eurostat.

Expected performance: The real rate of growth in pharmaceutical expenditure is expected to be positively related to changes in real per capita health care expenditures over time. Being the rate of growth, rather than real per capita expenditure in pharmaceuticals, it is not a linear function of health care expenditure per capita (LNHCE95), and is therefore unrelated to it. This variable shows the combined effect of changes in prices of medicines over time as well as the changes in volumes of medicines consumed over time. Policy-makers are interested in both effects. *First,* the price effect is critical because, in principle, it shows the rate at which new medicines are introduced in different countries and the extent to which they actually represent innovations or are perceived to be innovative in different national regulatory environments (and therefore achieve high prices in pricing/reimbursement negotiations). Prices of pharmaceuticals are typically rigid upwards particularly in environments where price controls exist, or price-volume agreements are in place between purchasers (sickness funds, health authorities, HMOs, etc). This would comprise all countries under investigation. Manufacturers, therefore, have an incentive to launch new products or marginal improvements over older products to achieve higher prices, assuming regulators or purchasers are convinced about the new products' innovative capacity. The empirical analysis that follows provides an opportunity to observe this variable across different regulatory regimes, namely, pricing freedom for new products (Germany, USA), relative pricing freedom, subject to profit control (UK), and different types of price control regimes (all other countries).

Second, the volume effect may show the impact of increased information flows, to the extent this information is accessible. Of course, different countries have different regulatory regimes applying to advertising (ranging from placing a ceiling on corporate advertising expenditure or taxing advertising expenditure (Kanavos, 1999), to banning direct-to-consumer advertising (Kanavos & Abramson, 2001)). Nevertheless consumers' direct access to information has increased in recent years through the internet. Changes in volume of medicines consumed over time also reflect public expectations and the impact of demand-side policies. It is, for instance, a reflection of differing expectations that consumption of medicines per capita in France is higher than all other industrialised countries, but it may also relate to the relative weakness of policies applied on the demand-side (Lancry, 1999). In contrast, the UK's per capita pharmaceutical consumption is nearly half the French figure, and this may be partly due to more effective demand-side measures being in place (Fattore, 1999).

5.3.2.4 Health Prices

Rationale: "It seems intuitively obvious that health care expenditures are determined by health care price levels" (McGuire et al, 1993). However, relatively few studies have explored the impact of price movements, but where this was done the studies showed some anomalies. For instance, the OECD compared real expenditure, using a health-specific deflator, with real GDP for a sample of 18 countries (OECD 1987). Overall, the average real expenditure elasticity for these countries was 1.6. When shorter time periods were looked at, the elasticity fell from 1.6 in 1960-75 to 1.3 in 1975-84. Moreover, the growth of expenditure relative to GDP slowed markedly in the 1980s, so that the mean elasticity for 1980-84 fell to

0.5 and real expenditure grew only half as fast as real GDP. The implication was that, after 1980, health care, previously a luxury, became a necessity for these countries.

(Real) price movements may therefore be important determinants of changes in health care expenditure because they may affect demand for health care services. Of course, the way that purchasers and citizens in different countries react to (upward) changes in prices differs dramatically, depending on several factors, for instance:

- The type of insurance funding (publicly funded, or private);
- The type of insurance cover (comprehensive or with high co-payments or deductibles, exemptions from cover); and
- The type of regulatory regime in place (price negotiation and capping for different goods and services, price – volume tradeoffs, strict price regulation, profit regulation, periodic price reductions and efficiency gains, etc)

To that end, this variable adds value to the model since it will be tested in countries whose systems present at least one of the above characteristics.

Definition, name of the variable and format: **PHEX**, which is the price index of health care expenditure in constant 1995 prices (1995=100). It is defined as the implicit price deflator for total current expenditure and investment, a weighted index for all components.

Data sources: OECD Health Data Base, OECD, Paris, 2000.

Expected performance: In principle, it is expected that prices and health care expenditures are positively related. The empirical investigation will show whether a statistically significant relationship actually exists. However the sign of the price coefficient will depend a great deal on the type of regulatory regime in place and whether there is some pricing freedom in the goods and services represented by the chosen health price index, or prices are regulated or negotiated. In the former case, a positive sign is expected, in the latter, the sign may well be negative.

5.3.2.5 Demographic factors

Rationale: As already discussed in chapter 4, much has been written about the implications for health care and expenditure of an aging population. For instance, it has been shown that medical expenses in France and Belgium are over three times greater for men aged 65 to 74 than for men aged 15 to 44. And expenses double for men over age 75 compared with the age group 65 to 74 (Sandier, 1987). On the other hand, the average annual effect of demographic change in Britain has been calculated as less than 0.3 per cent per annum for the next 35 years (Costain & Wolfson, 1994). In the past also, the effect has been far too small to account for more than a small part of the rising costs of health care in the developed world.

In view of this evidence, the thesis makes the case for not including an explicit ageing variable in the statistical analysis, advancing the view that if what matters is proximity to death after illness, then chronological age is irrelevant [79]. It is, however, expected that if there is an ageing effect in terms of higher utilisation, this will be picked up by other variables in the model, notably the technology variable.

5.3.2.6 Inputs to the health system (medical profession)

Rationale: Medical doctors represent an important input to the health care system and are directly responsible for much of a system's health care expenditure. In particular:

79 In so doing, the thesis also distinguishes between the macroeconomic and the microeconomic perspective(s). Whereas the burden of disease can be incorporated at micro level (see Wanless, 2002), this is not necessarily the case at the macro level, due to aggregation of the relevant data.

(a) Doctors are a costly input, in terms of reimbursement for their services, but to a variable extent between countries, depending on the organisation and delivery of health care services, the emphasis or not on primary care, and the methods of paying doctors.

(b) Doctors are responsible for making decisions on behalf of their patients, thereby influencing demand for health care.

Contrary to what theory might suggest, however, empirical evidence has been inconclusive about the extent to which the medical profession is a determinant of health care expenditures (Parkin et al, 1987; Gerdtham & Jonsson, 1991; Gerdtham and Jonsson, 1995). For example, an increase in supply may lower unit costs (i.e. average income). However, the thesis will explore the hypothesis that the number of doctors per capita are a determinant of health care expenditures within the remit of the present model.

Definition: The variable employed is "Practising Physicians, Practising General Practitioners, Practising Specialists". The variable is defined as the number of physicians, general practitioners and specialists who are actively practicing medicine in public and private institutions. The data excludes dentists, stomatologists, qualified physicians who are working abroad, working in administration, research and industry positions. Data include foreign physicians licensed to practice and actively practicing medicine in each country. Data have been calculated to represent full-time equivalents.

Name of the variable and format: **PHYSICIAN**, is the number of "Practising Physicians, Practising General Practitioners, Practising Specialists" per 1000 population.

Data sources: OECD Health Data 2000, OECD, Paris, 2000

Expected performance: Theoretically, a positive relationship between PHYS and health care expenditures should be expected, but the empirical evidence suggests that this relationship is inconclusive.

5.3.2.7 Systemic variables

Rationale: The effect of including institutional and system-specific variables in econometric analysis was discussed in chapter 2 of the thesis. Many authors included several dummy variables in an attempt to explain whether these constitute determinants of health care expenditures. Among them were, fee-for-service, capitation and salary as methods of paying doctors, and prospective budget or activity-based (case-mix adjusted or otherwise) formulae as methods of reimbursing hospitals. The pooling of data across twenty or so countries and over thirty years, and the resulting degrees of freedom, allowed a proliferation of dummy variables to be included, which, nevertheless, yielded results which authors themselves could very frequently not explain.

Rather, this thesis intends to add dummy variables in selected countries only. The justification for this is twofold:

(a) dummy variables are inserted to account for structural breaks in the data (for instance, German re-unification, which resulted in merging West and East German data post-1990), and which has remained unaccounted for in all previous empirical studies
(b) dummy variables are inserted to account for major shifts in policy and health care reforms, which may also result in structural breaks in the data. In particular, it is proposed that dummy variables be included for the UK, Germany, Sweden, France, and Austria and for specific periods only as outlined below for each country. For these periods, the dummy will take the value of 1 and it will remain equal to 0 for the remainder of the sample period.

5.3.2.8 Country dummies

(a) UK dummy =1 for 1991 – 1997; this dummy will account for the potential effect of market oriented reforms that were implemented in 1991 until the end of 1997.

(b) Germany dummy = 1 from 1991 onwards until the end of the sample period; this dummy will account for the effect of German re-unification and the structural jump in the data because post-October 1990 economic time-series also include East German data. Because macroeconomic time series are expressed in per capita terms, we do not expect a significant result.

(c) Sweden dummies. It is proposed to include two dummy variables for Sweden. One dummy is needed from 1992 onwards to account for the effect of planned market reforms; a second dummy is needed from 1993 onwards to account for the shift of social care to municipalities in 1993; although this took place in 1993, we will need to have the dummy for the entire sample period post 1993 because the policy shift did not have a one-off effect.

(d) France dummy = 1: a dummy for the 1996-1998 period will account for the Plan Juppé reforms. On November 15, 1995, Prime Minister Juppé, aware of rising deficits in the welfare sector announced a programme of reform of the French social security system, which would also explicitly affect the health sector. On one hand, the Plan Juppé announced emergency measures aimed at covering previous deficits, on the other it set out the guidelines for a financial and operational revision of the health care system in the medium term. Reforms included (i) increasing contributions by pensioners, the unemployed and private doctors, (ii) reducing coverage rates with an increase of the hospitalisation co-payment rate, (iii) imposing an exceptional tax on the pharmaceutical industry in the region of £250 million, (iv) targeting the growth rate of hospital and general medical expenditure for 1996-97 to equal general inflation, and (v) introducing an exceptional income tax of 0.5% of total income for a period of 13 years, starting in 1996, aimed at discharging the debt of social security.

(e) Austria dummy = 1: a dummy for the post 1996 period, when the Austrian authorities changed the way health care expenditures were estimated. Until 1995, Austria had been over-reporting. Following a recalculation in 1995, health care spending as a proportion of GDP fell from 9.6% to 8.1% (Österreichisches Statistisches Zentralamt, 1997).

5.4 The countries under investigation, functional forms and estimation procedures

5.4.1 The countries under investigation

The countries under investigation have been chosen to represent different funding methods and different versions within their funding methods. In particular, the countries, their respective funding methods for health services and the specific versions they represent are:

Country	funding method	version
1. U.K.	mainly general taxation 12% through non-earmarked national insurance	taxation mainly at central level
2. Spain	mainly general taxation	taxation mainly at central level
3. Portugal	mainly general taxation	taxation mainly at central level
4. Denmark	mainly general taxation	taxation mainly at local level
5. Sweden	mainly general taxation	taxation mainly at local level
6. Finland	mainly general taxation	taxation mixed (central and local)
7. Belgium	mainly social insurance	multiple funds (5 federations)
8. The Netherlands	mainly social insurance substitutes for statutory health insurance (40% of population)	multiple social insurance funds
9. France	mainly social insurance	1 fund covers 75% of population
10. Germany	mainly social insurance 10% of population has private insurance	multiple social insurance funds

11. USA	mainly private insurance publicly funded health care accounts for 42% of total health spending	multiple insurers
12. Switzerland	mainly social insurance a third of total health spending through private health insurance	multiple social insurance funds
13. Austria	Mainly social insurance (54%) but also taxation (24%)	multiple social insurance funds

The US and Switzerland have been selected to test the model in the case of health systems that contain strong private health insurance sectors. Appendix **5.1**, provides background information on each of the 13 countries chosen, particularly on issues related to finance, organization, provision, payment of providers, key problems, and main reforms over the past decade.

5.4.2 Functional form

The choice of functional form is of considerable importance in testing an empirical model. The thesis follows other published empirical evidence (among others Parkin et al, 1987; Gerdtham and Joensson, 1991; and Hitiris and Posnett, 1992) and makes use of a log-linear form of the model.

In addition, it uses a transformation to capture trends in the data which would otherwise lead to autocorrelation, namely by including time as an independent variable in levels, squared and to the power of three.

5.4.3 Estimation procedures

A two-step process is followed in estimating the model for each of the 13 countries selected. *First,* the model is estimated with Ordinary Least Squares estimation procedure and tested for autocorrelation in the residuals. Where autocorrelation is found, a first order Autoregressive

Regression [AR(1)] is run to correct for autocorrelation. *Second*, where autocorrelation persists even when the AR(1) method is used, then the model variables for each country are tested for trends in levels and in first differences. If trends are (or continue to be) present, then a co-integration approach is followed.

Chapter 6 pursues in detail the issue of estimation procedures and also summarises the relevant diagnostic tests that would ensure robust, and unbiased estimates from the empirical models presented therein.

5.5 Value added of the proposed analysis

The approach presented in the previous sections deviates from the existing literature of the determinants of health care expenditures in a number of ways.

First, it proposes a conceptual framework that links the determinants of health care expenditures to the theory of public finance, and allows flexible adjustments by decision-makers to account for changes in technology, population structure, prices, and the macroeconomic environment. The conceptual framework recognises that budgets for health care may need to be adjusted over time because of these changes. Their extent will determine the optimal size of the "health budget".

Second, the time series approach will be adopted to analyse the determinants of health expenditures on a country-by-country basis. This follows a limited number of similar previous attempts in the literature (Murillo et al, 1993; Saez et al, 1994; Kanavos & Yfantopoulos, 1999). A time-series approach enables the examination of dynamic patterns arising in the relationship between the dependent and independent variables, particularly the impact that change (in population structure, technology, growth in the economy) has on health spending. It will identify such patterns over a long period of time that would hold for a specific country rather than patterns that hold for a specific year across a number of countries, which may be subject to change because of a different reference year or a monetary denominator.

Third, the proposed methodology looks at the health production function within each individual country over a predetermined period without converting economic variables into a common currency. It therefore avoids the methodological problems that both the use of exchange rates and Purchasing Power Parities (PPPs) present in similar analyses for both macroeconomic and health indicators without sacrificing the possibility of comparing results across countries for similar variables. It also avoids some of the methodological problems arising from the same variables being collected and/or reported in different ways in different countries.

Fourth, the proposed analysis looks at the impact of the macro economy on health spending in two different ways. Firstly, it investigates whether the *rate of growth* in the economy, has any influence on the demand for health. Secondly, it investigates whether each country's public finances impact on health spending and to what extent.

Fifth, the proposed framework attempts to incorporate technology in order to analyse its impact on health care expenditures. This is an advance from published literature, which has most often considered technology as a residual. In particular, the impact of technological change is investigated in two separate ways: firstly, as an expenditure effect, thereby incorporating prices and volumes, and, secondly, as a price effect, looking at the impact of prices of health care goods and services only over time, and implicitly assuming volumes move in line with population growth over time.

Sixth, it recognises that the lag structure of the model is not sufficient to test for the impact of health determinants on health spending. Unfortunately there are no adequate data or variables to test this relationship. This is clearly a gap that future research and policy must address.

Finally, The analysis is conducted at the macroeconomic level and recognises that omitted variables such as the distribution of income in each country, health determinants, and the level of the parallel economy may determine some of the variation in health expenditures. Due to difficulties in accounting for these variables, their impact is deduced from the error term structure of each model.

5.6 Conclusions

This chapter has developed a conceptual model for the analysis of aggregate health care expenditures. The model is a spin-off from the theory of public finance and allows flexible adjustment of the health care budget in the face of need, this being due to changes in technology, changes in the prices of health goods and services, changes in the income of households, and allowing for adjustment in case of macroeconomic fluctuations. The model stresses the particular importance of technological change and that of prices of health goods and services. A number of variables have been selected to test the model empirically over the 1960-1998 period in 13 developed (OECD) countries. The analysis will test the significance of these variables as determinants of aggregate total health care expenditures and as determinants of aggregate public health care expenditures. The medium of analysis is time series regression analysis, with a first order autoregression process and, where needed80, cointegration analysis, and the functional form is log-linear. Following the analysis set out in the current chapter, chapter 6 will present the results of the econometric analysis, a number of diagnostic tests for the models presented, and will comment on the results obtained.

Appendix 5-1 Main features of the Health Care Systems Under Study

Austria	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by social insurance with mixed public and private providers. • Premia range from 5.6% of gross income for farmers, 6% for salary earners, 8.5% for liberal professions
Coverage by statutory health insurance system	99% of the population
Role of Voluntary Health Insurance	• Supplementary to statutory health insurance: premiums are calculated by actuarial methods and are tax-deductible up to a certain annual premium amount. • Up to 38% of population in 1990 had private health cover.
Main problems of health care system	• Increase in inpatient care in hospitals • Trend towards the use of expensive technology and other high-cost services • Monopoly position for scientifically trained physicians.
Main Health Care Reforms	• 1988: introduction of index-linked daily charges for hospital stays • End 1980s: an integrated health care system was established to shift the emphasis from hospital to outpatient care and to control hospital costs without loss of quality • 1993: recalculation of the health care basket, reducing HCE as a % of GDP from 9.4 to 8%.

80 In the case of trends in the data series, as will be explored in chapter 6.

Belgium	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by social insurance with mixed public and private providers. • There are also state subsidies from general taxation. • Contributions from old-age pensioners and taxes on car insurance account for the remainder
Coverage by statutory health insurance system	99% of the population
Role of Voluntary Health Insurance	Supplementary to statutory health insurance: small but steadily growing, offered by "mutualités" and for-profit companies.
Main problems of health care system	• Financial incentives which encourage the growth of expenditure • Rising volume of services induced by fee-for-service incentives • Very high numbers of physicians per 1000 population and above average physicians contact per capita
Main Health Care Reforms	• 1980: introduction of a new reimbursement system for pharmaceuticals • 1982: government announced reform in the hospital sector (reduction of the number of beds & prospective budgets to replace per diem payments) • 1983: increase in the rate of contributions to the health care system • 1988, 1989: new financing methods for laboratory testing • 1990: new policies for psychiatric services • Between 1992 and 1995, co-payments increased for inpatient care and ambulatory consultations in some cases by over 60%

Denmark	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by taxation with mainly public providers • Third-party payers include the state, counties, municipalities, and a private non-profit insurer • State subsidies were transformed in the 1970s into general block grants calculated on the basis of population & age distribution
Coverage by statutory health insurance system	100% of the population
Role of Voluntary Health Insurance	Minimal
Main problems of health care system	• Waiting lists increased for hospital services when cost-containment policies were implemented in the 1980s • Very high drug prices despite attempts to curb them
Main Health Care Reforms	• 1970: responsibility for health care was placed mainly with the counties, who became responsible for reimbursement in 1973. In 1977, they assumed responsibility for psychiatric hospitals • 1980s: cost-containment measures for improving efficiency and effectiveness at all levels • 1993: introduction of a scheme for cost-sharing drug prices • Since 1993: contracts have been gradually introduced between counties and individual hospitals. • 1998: health insurance expenditure on pharmaceuticals was limited to a 0.8% increase over that of the previous year.

Finland	
Variable	**Comments**
Financing of statutory health insurance system	• Mostly financed through general and local taxation • National government: approx. 30% • Municipalities: 33% • Sickness insurance: 13% • Households: 21% • Other private (relief funds, employers, private insurance) 4%
Coverage by statutory health insurance system	Universal: 100% of the population
Role of Voluntary Health Insurance	Limited; up to 4% of total health care costs
Main problems of health care system	• Multiple funding sources may lead to inefficiency in the use of ambulatory services • Large number of hospital beds since 1970s
Main Health Care Reforms	• Emphasis on primary and out-patient care since mid-1960s • Reduce numner of beds from mid-1990s onwards • 1990-95: Higher co-payments introduced • Flexibility for municipalities to charge for (some of) the services they provide • Introduce manpower control (doctors) • Change method of paying doctors as a means of providing performance-related incentives (from salary to capitation) • Continuous efforts to curb drug expenditure growth

France	
Variable	**Comments**
Financing of statutory health insurance system	Financed mainly by social insurance with mixed public and private providers through payroll contribution by employees and employers to the sickness funds.
Coverage by statutory health insurance system	99.5% of the population
Role of Voluntary Health Insurance	• Supplementary to statutory insurance • Covers 85% of the population • Income-related premiums to non-profit insurers (Mutuelles) • Risk-related premiums to private insurers.
Main problems of health care system	• Lack of control over expenditure in the ambulatory and private hospital sectors (but great choice) • Second highest drug consumption per capita in the world (but highest volume globally) • Above average consultations with doctors, medicines prescribed outside hospitals, and acute hospital admissions • Large number of doctors per 1000 population
Main Health Care Reforms	• Early 1980s and early 1990s: minor, piecemeal reforms to curb the rise of costs • 1984 &1985: introduction of prospective global budgeting for public hospitals to replace a system of controlled rates on increase of per diem rates. Increased cost-sharing • 1992 and 1995: hospital co-payments nearly doubled, and patients' contributions to hospital care expenses increased • Since 1996: regional hospital agencies are responsible for allocating funds to individual hospitals on the basis of the overall regional budget • Target budget was voted by parliament for 1997 (1.7% increase on the 1996 budget) • Additional tax to fund health care introduced as part of the Juppé plan • Gate-keeping with budgets introduced in late 1990s

Germany	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by social insurance with mixed public and private providers • Payroll contributions to Sickness funds • Taxes to the Länder
Coverage by statutory health insurance system	92.2% of the population (the remainder covered through private health insurance)
Role of Voluntary Health Insurance	• Substitute for statutory health insurance: those exceeding a certain income ceiling are entitled to pay risk-related premiums for private insurance • Covers just under 10% of population
Main problems of health care system	• General lack of self-consciousness because of the existence of third-part-payment • Excessive number of hospital beds, above average length-of-stay
Main Health Care Reforms	• 1989: reference drug prices are introduced to specify the level at which sickness funds reimburse prescription medicines • 1990: unification of East and West Germany, signifies major investment in health care in the East • 1992: per diem rates for hospitals are replaced by prospective payments made on a cost-per-case basis • Since 1993: the number of doctors treating sickness funds patients has been regulated, and contracts have been gradually introduced between counties and hospitals • 1997: fixed hospital budgets were replaced by individually negotiated target budgets • 1997: fixed budgets for doctors were replaced by volume targets • 1990s: co-payments were extended to cover hospital in-patient days and other services, and were extended further in 1997 • Planned introduction of DRGs in the late 1990s

The Netherlands	
Variable	**Comments**
Financing of statutory health insurance system	• Financed by a mixture of social and private insurance with mainly private providers • Flat payment plus a proportion of earnings to general fund mainly for employees earning below a certain salary • Compulsory tax to Exceptional Medical Expenses Fund.
Coverage by statutory health insurance system	72.2% of the population (the remainder covered by private health insurance)
Role of Voluntary Health Insurance	Substitute to statutory health insurance: those exceeding a certain income ceiling are obliged to leave the social scheme and entitled to pay risk-related premiums for private insurance
Main problems of health care system	• Large and expensive hospital sector • Long lengths of stay • Uncoordinated financing structure • Complex, rigid and costly government regulation • Several attempts at reform in 1980s and early 1990s, but little implementation
Main Health Care Reforms	• 1983: establishment of prospective global budgets for hospitals in place of cost-based reimbursement • 1992: pharmaceuticals are being paid for under the Exceptional Medical Expense Fund instead of the Health Insurance Act Fund, as part of the Dekker reform • 1996: cost-sharing measures extended • A target budget was decided by government for 1994-1998 (1.3% annual increase). Rate of increase was raised to 2.4% for 1998

Portugal	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by taxation with mainly public providers • Central government raises the funds and the Ministry allocates a budget to each hospital.
Coverage by statutory health insurance system	100% of the population
Role of Voluntary Health Insurance	• Government incentives to be insured privately • Covers 8% of the population. Most are covered indirectly through employment schemes or the purchase of financial service products • Provides cash benefits for hospital care and total coverage for all other treatments.
Main problems of health care system	• Majority of hospital beds and health professionals remain concentrated in urban areas • Multiple jobs of health professionals (NHS and private practice) • Difficulty in regulating the quality and quantity of care in the private sector • Difficulties in regulating the system. As a result, patients use more than one health system
Main Health Care Reforms	• 1971 and 1978: Social Security was extended to cover more categories of workers • 1974: "misericordias" (religious charity hospitals) were taken over by the government • 1975: local hospitals were taken over by the government • 1977: over 2000 social welfare medical units were taken over by the government • 1979: NHS was established, which extended care to all citizens • 1981: introduction of flat rate charges for home and office visits and diagnostic tests • 1982: charges were introduced for drugs and all hospital care, abolished in 1982, and reintroduced in 1992 • 1996: prospective budgets for individual hospitals were introduced taking into account hospital activities and planning priorities

Spain	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by taxation with mainly public providers • Taxes and social security contributions collected by the central government, who in turn distributes budgets to regional health systems and INSALUD
Coverage by statutory health insurance system	99.8% of the population
Role of Voluntary Health Insurance	• Public sector employees can choose the NHS coverage or a private insurance company • A significant proportion has opted for private insurance • Provides cash benefits and reimbursement for out-of-pocket and co-payments.
Main problems of health care system	• Large consumption of medicines • Long waiting times for public ambulatory care • Short consultations with physicians • Crowded emergency departments • Weak accounting permits a considerable amount of fraud to take place in the public sector
Main Health Care Reforms	• 1984: self-employed were brought into compulsory insurance, primary health care teams were created with full-time salaried doctors and nurses serving defined geographical areas, a national health system was created • 1984: INSALUD was decentralized to all the autonomous regions with a view of creating 17 regional health services, and right to free practice and freedom of enterprise for private clinics and hospitals were introduced • 1986 and 1987: health insurance under social security was extended to include uninsured dependents, and public hospital doctors were given financial incentives to work full-time • 1989: shift towards general taxation. Contributions were fixed and general taxation was left to take up the residual to make the system progressive • Late 1990s: transfer of budgetary responsibility to the 17 autonomous regions for the delivery of care

Sweden	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by taxation with mainly public providers • Local payroll tax to county councils and municipalities, general taxation to central government, and national payroll tax to National Social Insurance Board • Central government distributes equalization payments • Local government and municipalities responsible for delivery of care
Coverage by statutory health insurance system	100% of the population
Role of Voluntary Health Insurance	• Supplementary to statutory health insurance • Covers less than 0.5% of the population • Mainly covers care in private hospitals • Reimburses patients for co-payments, and pays private physicians and private hospitals through contracts
Main problems of health care system	• Lack of integration among health services • Difficulties in recruiting GPs in certain areas • Limitation on patient choice
Main Health Care Reforms	• 1970s: the responsibility for health delivery was transferred from the central to the regional and local level • 1980s: resources increased in hospitals and in primary care. • 1985: care for the mentally handicapped shifted from the health care budget to the education and social services budget • 1990s: Dagmar reform began in 1990 to target long waiting lists and aiming to increase capacity and access • 1992: shifting of responsibility for care of the elderly in nursing homes to municipalities • 1990s: fees for visiting hospital physicians were raised • 1990s: internal market reforms introduced in a number of regions • 1994: Minimum treatment time guarantee introduced for a number of procedures, but was later withdrawn

Switzerland	
Variable	**Comments**
Health system financing	• Financed mainly by voluntary insurance with mainly private providers • Federal government and Cantons and Communes collect tax revenues and make direct contributions at the federal, cantonal, and municipal levels to insurance agencies • Public health is heavily funded by the cantons
Coverage by health insurance system	99% of population
Role of Voluntary Health Insurance	• Risk-related premiums paid to private insurers • Premiums related to age at entry and region to Insurance Funds • Employer and government subsidies • Premium subsidies from government bodies to Insurance Funds.
Main problems of health care system	• Increased services caused by fee-for-service payments • Inefficiencies created by per diem payments for hospital stays • Lack of equity: health care premiums are risk-rated • Major differences in premiums due to uneven spread of risk across insurers • Since the late 1980s, premiums have been increasing because government has not been able to meet its commitment in terms of subsidizing them
Main Health Care Reforms	Some emergency measures to curb rising costs and to reinforce equity were adopted, such as limits on increases in premiums, limits on price increases in the hospital sector, and introduction of patient contributions towards treatment costs per hospital day. -1991: proposal for a fundamental long-term reorganization of the system, implemented in 1997 (compulsory social insurance)

United Kingdom	
Variable	**Comments**
Financing of statutory health insurance system	• Financed mainly by taxation with mainly public providers • Mainly through general taxation, supplemented by national insurance contributions
Coverage by statutory health insurance system	100% of the population
Role of Voluntary Health Insurance	• Supplementary to statutory insurance: risk-related premiums paid to private insurers who reimburse patients through cash benefits • Private insurance grew steadily until 1990 In 1995, 10.6% of population was covered • Slight decline in total subscribers since 1990
Main problems of health care system	• Long waiting times for elective and non-emergency surgery • Poor accountability • Limited choice • Post-code prescribing
Main Health Care Reforms	• 1982: government abolished that area health authorities and district authorities were introduced • 1991: creation of an "internal market " by the separation of purchasers from providers. Most providers became their own independent trusts with their own budgets and decision-making power. District health authorities became the main purchasers and hence appear as third-party payers. Hospitals funded by Health Authorities on the basis of annual block contracts and by GP fundholders usually on cost-per-case contracts • 1997: Labour reform establishes Primary Care Trusts, health targets, NICE, and CHI

USA	
Variable	**Comments**
Health system financing	• A significant private sector (VHI), coupled with federal and state assistance programmes • Private sector: financed mainly by voluntary insurance with mainly private providers • Federal & state assistance programmes: financed by general taxation; payroll taxes to federal government; and taxes to state government
Coverage by health insurance system	Adequate cover to approximately 75% of the population (both in terms of statutory health cover and private health insurance cover)
Role of Voluntary Health Insurance	• Mostly risk-related premiums paid to traditional and managed care organisations • Employer provision of voluntary health insurance, encouraged by tax breaks
Main problems of health care system	• Rapid growth of health costs • Lack of universal access to insurance coverage – inequity • Geographic mal-distribution of providers • Underutilization of primary care and preventive services, in favour of 'curative' services • Unequal access to services
Main Health Care Reforms	• Development of coordinated care networks (HMOs and PPOs) and recent convergence centred around managed competition • Increases in employee cost-sharing • Expansion in state Medicaid assistance programmes • Debate about introducing Rx drug coverage for Medicare

Sources: Author's Compilation from the following sources: Mossialos and Le Grand (1999), Hoffmeyer and McCarthy (1994), 1999 OECD Health database, OECD Health Policy Study No. 2 (1992), OECD Health Policy Study No. 5 (1994), and Kanavos and Mossialos (1999).

Appendix 5-2 On the interrelationship between income, wealth and consumption

The relevance of wealth in economic policy-making has acquired a new momentum, especially since the last recession in many countries in the industrialised world was largely a wealth driven downturn. For instance, the UK economy suffered a prolonged recession, after a rather long period of boom, and output, consumption and employment took an unusually long time to recover. This was due to a negative wealth effect following the stock market crash in October 1987 and the subsequent collapse in property prices from the end of 1988 onwards. The increasing financial liberalisation of the 1980s led to high growth in access to and use of credit, which was considerably beyond the growth in earnings. At the same time, with increased credit and low mortgage rates, property prices were bid up and when finally expectations of future increases faded and the bubble burst, the result was high levels of debt and debt interest payments outstanding. In this light, consumption fell dramatically and savings increased, as households struggled to balance their budgets.

Wealth was therefore important in the UK case, as it was (and is) in many other economies, in particular, the US, Japan, and Sweden, among others. In addition, there is a striking similarity between what happened in Sweden (Jonung and Stymne, 1994), Japan (Kaku, 1994) and the UK, as all three countries experienced almost the same type of shock, with their equity and property markets initially booming and subsequently contracting. In both Sweden and Japan the shock impacted on the economy more adversely than in the UK. The case of Sweden reflects the difficulties faced by the freshly deregulated banking sector; in Japan, the property boom was of a larger proportion than in the UK, following equity inflation.

From the accounting point of view, private non-human wealth amounts to several times the Gross Domestic Product in all industrialised countries. The literature, so far, has recognised, partially only, the importance of wealth in the conduct of economic policy, and wealth has been included, as a flow, in the aggregate demand function. This has a long-standing and sound foundation in economic theory. As early as 1948, Friedman & Savage in their discussion on the allocation of risk deliberately included wealth in the demand function of individuals that maximize an inter-temporal utility function. In fact, the importance of liquid and illiquid assets as parts of wealth in the UK is quite substantial and averages 35% over a period of 25 years, from 1966 to 1989. Therefore, given the momentum of net wealth as compared with GDP figures, it follows that liquid and illiquid assets play a substantial role in determining consumption and can, indirectly, but, definitely, influence output itself or output decisions.

In this light, there is general acceptance of the following functional form for non-human, real net financial wealth:

Real Net Wealth = Σ (money, equities, government debt, foreign assets)

The empirical literature that uses versions of the above functional form for wealth is substantial, but by no means extensive. In particular, Barrell et al (NIESR, Oct. 1991), use the National Institute/LBS global econometric model (GEM), to analyse adjustment processes within a European Monetary Union. In this model wealth is incorporated and is defined as above. In addition, the European Commission's econometric model, Quest, uses, more or less, the same definition of wealth in its description of the economies of 12 Member States and their interaction in the presence of economic policy shocks.

Although theorists, practitioners and policy-makers have realised the importance of components of wealth for the conduct of economic policy, and, thus, have incorporated parts of it in econometric models, there is still a component of wealth, the property market, that remains unaccounted for. Yet, dwellings account for approximately half of total non-human wealth in the UK, with similar being the situation in other OECD countries. There has also been a tendency for wealth from dwellings to increase over the last two decades, at the expense of savings, shares and government debt. This was largely due to financial deregulation and liberalisation that started in the late 1970s and was completed in the 1980s, following the US example of liberalising markets in 1975. Financial deregulation made cheap credit available to individuals, thus benefiting from low interest rates, whereas financial liberalisation further implied freedom in the movement of capital across Europe.

As in the U.K. the property market is important in most other Member States of the European Union. A very large percentage of the European population occupies its own home; the percentage for the UK alone was 67% in 1993. The low percentages for Germany, Netherlands and Denmark, do not necessarily imply that house ownership in these countries is low. It could be that people are very mobile and because their income is high they choose to live in other properties, leasing their own. Home ownership, as well as the ability to lease has implications for the disposable income of individuals, which becomes even more accentuated if no mortgage or other types of debt exist. Therefore, the property market ought to be incorporated in the wealth function as an active component. Such an inclusion would have a number of implications for the conduct of economic policy:

first of all, ownership of a dwelling implies that individual disposable income increases by the amount of rent or mortgage that individuals would otherwise pay. Where ownership is subject to mortgage payments, the additions to disposable income are still considerable if the following facts are taken into account: first, a mortgage has a finite life, therefore an individual will enjoy the benefits of full ownership after the expiry of their mortgage, which is usually before the end of an individual's productive life in employment; secondly, a mortgage does not hinder individuals from leasing property at a rate lower than their mortgage, thereby making a net profit; thirdly, a mortgage is usually preferable to renting property on cost grounds. To the extent that individuals end up with higher disposable incomes, we then have to consider the implications that the additional income has on individual consumption, saving and investment. Finally, we must consider the amount of tax relief obtained by a household (or an individual) opting for a mortgage.

Secondly, ownership implies a net addition to individual assets and renders individuals less susceptible to economic policy changes. This implies that changes in economic policy affect owners less than non-owners (mortgage payers). Recent Family Expenditure Survey data showed that, amidst the recent recession in the UK, the consumption of households with a mortgage fell, whereas that of households without a mortgage increased. The difference between the two groups was six percentage points. In addition, ownership may change individuals' attitude towards risk when investing; in a nutshell, the larger the wealth pool, the more risk-neutral (sometimes risk-loving, too) individuals become. The theoretical justification for it has its roots in Friedman and Savage's pioneering work in 1948.

Thirdly, at the international economic policy level, in particular, within the EU, the way the impacts of wealth were highlighted in the previous subsection do not sufficiently explain why some Member States continue to afford to run balance of payments deficits, despite the hypothetical equilibrating effects of asset decumulation described above. In countries like Greece, Spain, Italy, or, even, France the effect of the property market on the demand function could provide such an explanation, whereas in the case of countries like the UK, the

US and Japan, the joint effects of a strong property market with a very powerful equity market may indeed account for the overall wealth effect.

It follows therefore, that the property market is too important to be left out of economic policy considerations. In addition, the implications that property ownership may have for disposable income and thereby, affecting consumption, investment and saving, should be thoroughly analysed. Given the importance of the wealth effect and its components as outlined above, the wealth function is as follows:

Net Wealth = Σ (property, equity, bonds, money)

Finally, empirical evidence exists on the interaction between wealth and consumption, the former (through its various components) affecting the latter.

CHAPTER 6 EMPIRICAL RESULTS AND DISCUSSION OF THE TIME-SERIES MODEL

6.1 Introduction

This chapter builds on the methodological problems associated with the analysis of health care expenditures identified in chapters 3 and 4 and the analytical - conceptual framework proposed in chapter 5. This chapter tests empirically the model that was outlined in chapter 5 for 13 OECD countries and for the 1960 – 1997 period. In doing so, it acknowledges the points raised in earlier chapters regarding: (a) the methodological problems with the use of GDP as an adequate measurement of national income; (b) the methodological problems with the use of different denominators of monetary values, such as exchange rates and Purchasing Power Parities; (c) the problems that may arise with the use of different estimation methodologies, such as cross-sectional analysis and pooled cross-sectional analysis; (d) the extent to which prior empirical investigations relied on an analytical framework, or on empirical causal relationships that appeared sensible at first glance. In acknowledging the above points, the analysis pursued here relies on time series, does not use any denominator for monetary values, and, for methodological consistency, examines the determinants of health care expenditures on a country-by-country basis and for each of the 13 countries individually. The empirical evidence is presented in two stages: the first presents conventional time-series analysis, in particular, the first order autoregressive correction, whereas the second builds on the theory of and empirical evidence on trends in time series and co-integration analysis.

By estimating the determinants of health care expenditures in light of the theoretical arguments presented in chapter 5 and the methodological arguments made in chapters 3 and

4, the methodological approach presented herein also aims to address empirically the question of whether health care is a luxury good, in other words, whether the income elasticity of demand, measured by GDP, is greater than unity. The sole purpose of doing so is to ascertain whether the analytical framework presented in the previous chapter leads to empirical results that are significantly different from the ones already published in the international literature over the 1960-2000 period.

In light of this, two streams of empirical investigations are therefore followed in this chapter: the first includes GDP for purposes of comparison with the published empirical literature so far, whereas the second pursues the inclusion of total consumption, as a measure of national wealth, in the empirical investigation and is therefore consistent with the analytical framework presented in the previous chapter.

Section 2 explains the rationale for using the two step process for conducting the empirical investigation. Section 3 describes the rationale behind the use of the first order autoregressive error correction and identifies the suitable test(s) for it. Section 4 presents and comments on the results of the model using the first order autoregressive error correction method. Section 5 explains the significance of unit roots and identifies methods of testing for them. Section 6 presents and discusses the results of the unit root tests for each of the 13 countries in our sample. Section 7 presents the theoretical framework underlying the use of co-integration analysis and discusses the prevailing tests for co-integration, thus focusing on the Johansen procedure. Section 8 presents and comments on the Johansen co-integration tests for each of the 13 countries in the sample. Section 9 presents and comments on the overall results of co-integration analysis for the full model and, finally, section 10 draws together the conclusions of this chapter.

6.2 Empirical results in two parts: First Order Autoregression and Co-integration

This section briefly explains what model(s) is (are) tested and what econometric procedures are used. In particular, The remainder of this chapter presents the empirical evidence in two parts: the first, consisting of sections 2 and 3 of this chapter, discusses the rationale behind the use of the first order autoregressive correction procedure (AR(1)) and presents the empirical results of the model of the determinants of health care expenditures. In addition, the statistical relationship between health care expenditure and GDP is tested in a simple regression equation. The models tested in this part comprise the following functional forms in each country:

Model 1: LNHCE95 = f(LNGDP95, AR(1))

Model 2: LNHCE95 = f(LNGDP95, DEFPCT, PHYS, LGLNGDP, PHEX, PHRMPCT, AR(1))

Model 3: LNHCE95 = f(LNC95, DEFPCT, PHYS, LGLNGDP, PHEX, PHRMPCT, AR(1))

Where LNHCE95 is the logarithm of health expenditure in national currency and in constant 1995 prices; LNGDP95 is the logarithm of gross domestic product in national currency and in constant 1995 prices; LNC95 is the logarithm of total national consumption in national currency and in constant 1995 prices; DEFPCT is the annual change in government deficit, measured in national currencies; PHYS, is the total number of physicians; LGLNGDP is the lagged logarithm of total national health care expenditures, measured in national currency and expressed in constant 1995 prices; PHEX, is the health price index; and PHRMPCT is the technology variables, measured as change in total national pharmaceutical expenditure (prescription medicines), measured in national currency and expressed in constant 1995 prices.

The second part of the empirical evidence, comprises sections 5 – 9. The addition of this part has become essential due to the AR(1) method being insufficient to produce robust results for 12 of the 13 countries in the analysis, the only exception being Portugal. Sections 5, 6, 7 and 8 prepare the ground for the conduct of co-integration analysis in section 9. Section 5 highlights the significance of unit root tests, starting with the rationale behind the use of unit root tests, proceeding with an analysis of the Augmented Dickey Fuller test, as the key test for the presence of unit roots in variables, and concludes by offering unit root tests for all variables and for the 13 countries in the sample (including Portugal, in order to check the validity and robustness of the estimates obtained in the previous analyses on that country) by testing levels of integration. Section 7 discusses the theoretical rationale for co-integration and outlines the rationale for the Johansen procedure, which tests for co-integration among different variables. Section 8 presents the Johansen results for all 13 countries in the sample and also presents the co-integrating regressions for each of the countries in the sample. Two such co-integrating regressions are presented per country, one that is formed with GDP as a regressor and one with total consumption as a regressor. Finally, section 9 presents the results of the co-integration analysis.

6.3 The First-Order Autoregressive Error Correction

6.3.1 Theoretical rationale and testing

The previous section outlined the models that would be tested empirically for each of the countries in the sample. Ordinary Least Squares (OLS) was initially chosen as the estimation method but having run preliminary models with OLS, it was found that, with the exception of Portugal, all country models suffered from autocorrelation or serial correlation in the residuals.

Autocorrelation almost exclusively arises in cases where the data have a time dimension (time series) (Verbeek, 2000). It implies that the covariance matrix is non-diagonal such that two or more consecutive error terms are correlated. The reason could be persistence in the unexplained part of the model. Persistence of the effects of excluded variables is therefore a frequent cause of positive autocorrelation. The consequences of autocorrelation are that OLS estimates remains unbiased, nevertheless OLS yields inefficient estimates and its standard errors are estimated in the wrong way. Results from autocorrelated relationships cannot therefore be taken into account and models using OLS as an estimation method must be corrected for autocorrelation. This is done by using the first order autoregressive correction procedure or AR(1) correction.

The first order autoregressive correction procedure, [AR(1)], is a technique that deals with serial correlation as a statistical problem. It is brought into play after having explored improved specifications that eliminate serial correlation of the residuals by taking into account all slowly moving influences. When the disturbances of a linear regression model are serially correlated, the coefficient estimates of ordinary least squares are inefficient, although still unbiased. The AR(1) specification provides a method to obtain efficient estimates when the disturbances display first order serial correlation (Rao and Griliches, 1969).

The disturbance process implicit in the AR(1) procedure says that the correlation of this disturbance with its own lagged value is a parameter rho. Rho is the first-order serial correlation coefficient. In effect, the AR(1) procedure incorporates the residual from the past observation into the regression model for the current observation.

When changing to AR(1) correction in a model, the interpretation of the coefficients, standard errors, and t-statistics is unchanged. However almost everything else has changed substantially and, to understand it, it should be noted that there are two different kinds of residuals associated with AR(1) estimation. One kind is the unconditional residual, computed just as in ordinary least squares: the dependent variable minus each original independent variable multiplied by its regression coefficient. If a prediction is made without knowing the lagged residual, the unconditional residual is the error that is made. If the unconditional residuals are computed after the AR(1) has been run, it will be found that they are serially correlated.

The other kind of residual is the one-period-ahead forecast error, which, as its name suggests, is the error made if a forecast is computed by applying the coefficients to the independent variables and then adding the prediction of the residual from its own past value. Because of serial correlation, these residuals will tend to be smaller; the forecast is improved by taking advantage of the predictive power of the lagged residual. The improvement will always be available in the standard error when the AR(1) is used and reflects the extra predictive power of the lagged residual. This improvement only applies when a forecast can be made, already knowing the forecast error from the immediately preceding period.

A statistic unique to AR(1) is r, the serial correlation coefficient of the unconditional residuals. It is the coefficient of the AR(1) term in the equation. The value of r lies between -

1 (extreme negative serial correlation) and +1 (extreme positive serial correlation). If r is roughly zero, serial correlation is absent, and the AR(1) technique is not needed. The value of r feeds into the Durbin-Watson (DW) statistic, which is the test traditionally used to detect serial correlation in the residuals[81]. The r reported by AR(1) will be related to the Durbin-Watson statistic from the corresponding least squares regression in roughly the following way: if r is doubled and then subtracted from 2, the Durbin-Watson statistic is obtained.

Having identified the rationale behind the use of the AR(1) method, and the significance attached to the Durbin-Watson (DW) test statistic, we proceed to estimate the models identified previously with that method, as the use of OLS has indeed yielded results with autocorrelation in the residuals. The AR(1) results are explained in the following section.

6.4 The determinants of health care expenditures

6.4.1 The statistical relationship between Health Expenditures and GDP in a simple regression model

We wanted to investigate the hypothesis that the simple relationship between health care expenditures and GDP results in an income elasticity of demand greater than unity, indicating that health care is a luxury good. This has been one of the major conclusions of the literature since the early 1960s. We therefore tested that relationship for each of the 13 countries in our sample. In addition to the AR(1) method and in order to balance out the likely impact of trends in the data, we pursued two transformations, one quadratic and one that added a time-trend every three years in the sample. All financial data are expressed in local currency units, in constant 1990 prices. By using local currencies we avoided the problems of denomination

81 The DW statistic is based on the one-period ahead forecast errors.

into a common currency through exchange rates or purchasing power parities that were discussed in chapter 4. The results are summarised in table 6.1.

For France, the UK, Sweden, Denmark, Portugal and Switzerland, the relationship between health care expenditures and GDP is positive, but, very importantly, not statistically significant. This means that GDP cannot be shown to explain any of the variation in health care expenditures over time.

For the Netherlands, the relationship between health care expenditures and GDP is statistically significant (at the 1% level), but it is negative, indicating a cyclical effect. However, the persistence of autocorrelation in the residuals, despite the use of AR(1), places a query on the validity of this relationship.

For Germany and Finland, the relationship between health care expenditure and GDP is positive and statistically significant, but the value of the coefficient/elasticity is very substantially lower than unity in Germany (β = 0.358), and lower than unity in Finland (β = 0.829). This indicates that in both cases health care is a normal rather than a luxury good.

For Austria, Belgium, Spain, and the USA, the income elasticity of demand is greater than (Austria, Belgium, Spain) or equal to unity, indicating that for these countries health care is a luxury good.

The results suggest that in the majority of countries, GDP either does not explain any of the variation in health care expenditures or when it is statistically significant, its coefficient (value of the elasticity) indicates that health care is a normal rather than a luxury good. This result challenges the vast majority of empirical evidence on the subject. The variety of the results obtained for different countries on a time series basis and by using national currency units implies that, if anything, the use of cross-sectional or panel data in similar investigations produces results that are of little practical use to policy analysis. In addition, it confirms how the use of exchange rates or PPPs may lead to different results.

6.4.2 Testing the determinants of health care expenditures in a multi-variate model

After testing the relationship between health expenditures and GDP in a simple regression model for each of the 13 countries of the sample, we proceed to estimate the full model by using the AR(1) method. This is done in two separate steps. In the first, we estimate the full model, which includes GDP as a measure of national income; the results for each of the 13 sample countries appear in table 6.2 and a summary of the performance of GDP is shown in table 6.3. in the second step, we estimate the full model again, but this time, we include total consumption as a proxy for total national wealth. The results of these estimations for each of the 13 sample countries are shown in table 6.4.

6.4.2.1 Determinants of health care expenditures and the importance of GDP as an independent regressor

The results of the linear regression analysis are presented in table 6.2 for each country. For each country a set of equations is shown where the dependent variable is the total expenditure on health. The period covered by the statistical analysis ranges from 1960 to 1997 for each country. The tables show the values of coefficients and the t-statistics in brackets. Linear regression analysis is applied, the method of estimation being a first order autoregressive process [AR(1)]. Variables involving monetary values are expressed in local currencies and are in 1995 constant prices; the logarithms of these values are subsequently taken. Since population in the 13 countries has been relatively stationary over the past 38 years, the analysis has avoided expressing values of both the dependent and independent variables in per capita terms; this avoids multi-collinearity in the models. Various specification and diagnostic tests have been applied to all reported equations, including those for higher order (2nd and 4th respectively) autocorrelation, autoregressive conditional heteroskedasticity (ARCH), White heteroskedasticity, and normality.

The relationship between income and health expenditure

The equations presented in table 6.2 test the extent to which income, expressed in terms of GDP in national currencies in constant 1995 prices, is, among other variables, a determinant of health spending in each of the 13 sample countries. They also attempt to show how income interacts with other potential determinants of health expenditure. The linear relationship has been tested against the total spending on health. The evidence suggests that the relationship between national income and health spending is far more complicated than it was originally thought to be and it certainly contrasts with the results of the empirical literature to date.

The inclusion of national income, expressed as the logarithm of GDP at constant 1995 prices involved two steps: first, the inclusion of GDP at current levels and, second, the inclusion of GDP in lag format (1-year lag). The empirical results are presented in table 6.2, and table 6.3 summarises the following two relationships:

(i) health care expenditures and GDP and

(ii) health care expenditures and lagged GDP

As all variables are expressed in logarithms, the coefficient of GDP or lagged GDP is the value of the income elasticity of demand, which will allow us to infer whether health care is a normal or a "luxury" good.

The key messages emerging from the statistical analysis are as follows:

- First, in seven countries, income was shown to be not at all significant in explaining any of the variation in health expenditure (Denmark, Finland, France, Sweden, Switzerland, UK, and USA). This result was robust and suggests that other variables play an important role in explaining the variation in health care expenditure.
- Second, in three other countries (Germany, the Netherlands, and Spain), the results were ambiguous for two reasons: first, model specification may render GDP non-significant, implying that GDP is not the main determinant of health care expenditure; second, persistent autocorrelation in some of the models may influence the robustness of the estimates.
- Third, in the cases of Belgium and Portugal, model specification determines whether GDP is statistically significant or not. The results are therefore ambiguous at best. In the case of Belgium, the GDP coefficient has a negative sign in all models, thereby implying the negative association between GDP and health care expenditures, which is contrary to what is normally expected from such an association. The value of the coefficient is greater than unity in some cases and very significantly below unity in others, leaving no ground for concrete conclusions to be drawn. In the case of Portugal, the sign of the GDP coefficient is positive, which is in accordance with expectations; the value of the coefficient, on the other hand, ranges from greater than unity to significantly lower than unity.

- Fourth, the only country where GDP was found to be statistically significant in all models was Austria. The level of significance ranged from 5% to 10%. The sign of the coefficient was positive in all models, which is consistent with expectations, and the value of the coefficient was below unity in all models, although close to unity.

Following the weak performance of income at current levels, the relationship between current levels of health spending with previous levels of income (LGLNGDP) was tested, based on the hypothesis that current income could determine future expenditure on health, or that present expenditure on health is determined by past income levels, particularly in tax-based systems, where decisions about the funding of health services are made on the basis of budget allocations and involve cabinet decisions (especially in the UK, Denmark, Portugal, Spain, and Sweden). The results from testing this hypothesis are also summarised in table 6.3.

- First, as can be seen from table 6.2 and table 6.3, the analysis rejected the above hypothesis in the majority of cases (Belgium, Denmark, France, Germany, Portugal, Sweden, USA), which found no significant association between past levels of income and health expenditure.
- Second, in all remaining countries of the sample (Austria, Finland, the Netherlands, Spain, Switzerland and the UK) the results are ambiguous in terms of statistical significance of the lagged income variable, and largely depend on model specification. Model specification also affects the value of the lagged income coefficients. In the case of Finland, the Netherlands, and Spain, the persistence of residual autocorrelation (despite the use of the AR(1) method) makes the credibility of the results problematic.
- Third, the simultaneous inclusion of GDP in levels and one-year lags, does not improve the explanatory power of GDP as a predictor of health care expenditure.

In conclusion, the individual country analysis has shown that the aggregate relationship between income and health spending has been exaggerated in the literature and that other variables must be responsible for any escalation of health spending.

The impact of the medical profession

Doctors as gatekeepers and prescribers are key to the determination of health care costs. In addition, the method of paying doctors may lead directly to an escalation in total health care expenditure. We tested for the role of the medical profession contributing to the explanation in the variance of health care expenditures by including the number of physicians in multi-variate analysis. In the majority of countries (Austria, Belgium, Denmark, France, Germany, the Netherlands, Sweden, Switzerland, UK), the number of medical doctors is not associated significantly with health care expenditures and fails to explain any of its variation. Whereas previous studies modelling the relationship between the medical profession and health care expenditures found positive (or even negative) statistical relationships, this is not the case for 9 of the 13 countries in the sample. Three countries displayed a significant statistical relationship (Finland, Portugal, and Spain), although in the case of Portugal the sign of the physician variable was negative. Finally, for the US the results are indeterminate, as the reported models still suffer from the presence of autocorrelation. These results contrast with some of the results in the existing literature, such as Gerdtham et al and Saez et al., which appear to be conclusive on the positive impact of the medical profession.

The results obtained highlight the inadequacy of the physician variable to explain any of the variance of health care expenditures in the majority of the sample countries. This is not surprising, as this variable can only account for the number of physicians practising in a given country, but cannot account for what or how much they authorise/prescribe, or, even, the extent to which they are employed by health insurance organisations, or they are self-employed (or both). The data are also subject to definitional problems, often failing to differentiate those working in mainstream clinical practice from others, or different patterns of working. Finally, in any particular country the year-to-year variation in numbers is relatively small.

The impact of budget deficit

The impact of the year-on-year change in the budget deficit on health care expenditures was also examined, both in level and lagged terms. The lagged variable did not yield significant results. In the case of the variable in level terms, the evidence is mixed at best. In Belgium, Finland, Germany, Portugal, and Spain, the budgetary situation is not associated with health care expenditure.

In Austria, France, Switzerland, and the UK, there is a statistically significant association, which is negative, whereas in Sweden this association is positive. This means that movements in the economic and budgetary situation affect health care spending cyclically (i.e. both variables move in the same direction, as in the case of Sweden) or counter-cyclically (i.e. the two variables move in opposite directions, as in the case of the other four countries). In the latter case, an increase in the budget deficit affects health care expenditure negatively, or, equally, a decrease in the budget deficit contributes to increases in health care spending. This type of movement may be more plausible than the former in which there is co-movement between deficit and health expenditure.

In Denmark, and the Netherlands there is some evidence of a negative (and statistically significant relationship at 10% level) between fiscal deficit and health care expenditures, but this is weak and is affected by the inclusion of the GDP variable. Finally, in the case of the USA, the impact of the budget deficit is indeterminate, as all reported models are still affected by the presence of autocorrelation.

The impact of technology

Technology has been proxied by the rate of growth in pharmaceutical expenditure. Evidence is available on and is presented for 11 of the 13 countries (i.e. excluding the UK and the USA). The model would break down in the case of the UK and would still have autocorrelation in the USA. In Austria, Denmark, Finland, France, and Germany there is a positive and statistically significant association between growth in pharmaceutical expenditure and health care expenditure, whereas in Belgium, the Netherlands, Portugal, Spain, Sweden, and Switzerland there is no significant association. This result is to a certain extent expected, as the two groups differentiate the relatively lax price-control countries in the first case and the command-and-control countries in the latter. The inclusion of France in the former group does appear to be a paradox, since the country is, strictly speaking, a "price control" country, but it can be explained by the way that France has moved gradually towards a system of price negotiation that places a premium on innovation.

The impact of prices

Health prices were proxied by implicit price deflator for total current expenditure and investment, a weighted index for all components, which was available for constant 1995 prices. Our original hypothesis suggested that prices and health care expenditures would, in principle, be positively related. The sign of the price coefficient would depend a great deal on the type of regulatory regime in place and whether there is some pricing freedom in the goods and services represented by the chosen health price index, or prices are regulated or negotiated. In the former case, a positive sign is expected, in the latter, the sign may well be negative.

The evidence from table 6.2 suggests that in 5 of the 11 countries for which results are available (Denmark, Finland, France, the Netherlands, and Switzerland), there is a positive and statistically significant relationship, whereas in the rest of the countries no significant relationship was found. The existence of autocorrelation in the US data does not allow any conclusions to be drawn. For Spain the model breaks down.

6.4.2.2 Determinants of health care expenditures and the importance of Total Consumption as an independent regressor

The inclusion of total consumption in our models, as a proxy for total national income and as a likely determinant of health care expenditure was debated in chapters 3 and 5. The results of analyses of this proposed association are shown in table 6.4. In 4 of the 13 countries of our sample (Finland, Germany, the Netherlands, and the USA), autocorrelation still remains a problem, therefore, the results are of questionable robustness and will not be commented upon further.

The impact of total consumption

Total consumption was defined as the logarithm of real total private consumption for goods and services, expressed in 1995 constant prices. The lag of this variable by one period has also been used in the analysis to be consistent with the conceptual model put forward, namely that expenditure at a point in the future may depend on income generated at present. It was hypothesised that, if there was a relationship between aggregate macroeconomic variables and total health care expenditures, it would be captured by the consumption variable. The expectation was for that relationship to be positive, such that an increase in total final consumption would be due to higher income from employment, other income which may be generated in the informal sector, and positive perceptions about individual financial and non-financial wealth. In 6 of the 9 countries for which there is comparable evidence (Austria, Denmark, France, Portugal, Spain, and the UK), there is a positive and statistical relationship between total consumption and total health care expenditure. This statistically significant association confirms our original hypothesis, that consumption might provide a better measure of total implicit income in the economy, if income was at all to be related to health care expenditure.

Of the three remaining countries, Belgium and Switzerland displayed no statistically significant association between total consumption and health care expenditure, whereas in Sweden that association was significant but negative. The last case could only be explained if a decline in consumption led to an increase in health care spending, from the point of view that reduced consumption implies a depressed economy, which, in turn, may imply higher unemployment and incidence of illness. Finally, lagged consumption was not significantly associated with health care expenditure, with the exception of the UK and Spain.

The impact of the medical profession

Of the 9 countries with robust results, 5 (Austria, Belgium, Denmark, France, Sweden), displayed no statistical association between the number of physicians and health care expenditure, whereas in 3, (Portugal, Spain, and Switzerland), the association was (weakly) statistically significant and negative in sign. Only in the UK was the association positive and statistically significant. These results broadly compare with the evidence presented in the previous section (where GDP was an independent regressor) and highlight the questionable nature of empirical results from the published literature showing a positive and statistically significant association.

The impact of GDP growth

The rate of growth of income was also included in the empirical analysis pursued in this section, to test the hypothesis that GDP growth rates may determine the extent of spending on health rather than current levels of GDP. It emerged that GDP growth is not statistically associated with health spending in 7 of the 10 countries for which robust results have been obtained (Austria, Denmark, France, Portugal, Spain, Sweden, and Switzerland); of the remaining 3 countries, in Finland and the UK the association is weakly significant, but changes sign depending on model specification, which implies that no reliable results may be obtained. Only in the case of Belgium was there a statistically significant association, but it was shown to be negative and rather counter-intuitive (an acceleration in GDP growth leads to deceleration in health care spending.

The impact of budget deficit

Two types of budget deficit variables were included in statistical analysis: the first being national deficit in levels, the second being year-on-year changes in budget deficit levels. With regard to the impact of the budget deficit in level terms, of the eight countries that yielded robust results, in three (Austria, Denmark and France) budget deficit was negatively associated (statistically significant) with health care expenditures. In the remaining five (Belgium, Portugal, Spain, Sweden, Switzerland), no evidence was found of a statistically significant association. With regard to year-on-year changes in the budget deficit, only in three countries was the association between health care expenditures and changes in budget deficit statistically significant: in Austria and the UK the relationship was found to be negative (as expected); by contrast, in Sweden it was found to be positive. Both types of relationships highlight anti-cyclical (in the first two cases) and cyclical (in the latter case) behaviour in fiscal stance in the countries in question. By contrast, in Belgium, Denmark, France, Portugal, Spain, Switzerland, the relationship between health care expenditures and changes in budget deficit was not statistically significant.

The impact of technology

The impact of technology was mixed. Of the nine countries that yielded robust results, five had a statistically significant association whereas in four the association did not yield statistically significant results. In Austria, Denmark, France and the UK, the relationship between health care expenditures and changes in technology was positive, which leads us to conclude that technology is a net contributor to health care costs. The negative sign of the technology variable in Portugal could be associated with that country's attempts to expand coverage and health care provision in general, as well as its long-term stance in favour of regulating drug costs via a command and control regulatory system. In Belgium, Spain, Sweden, and Switzerland the relationship between the technology variable and health care expenditures was not statistically significant.

The impact of prices

Of the 9 countries that yielded robust results, the association between prices and health care expenditures was positive and statistically significant in Belgium. This means that prices contributed significantly to health care costs. In Denmark, France and Spain, the relationship was negative and statistically significant, which implies that price changes did not contribute to the escalation of health care expenditures. This may be due to price freezes, price cuts, or other intervention on prices, for instance, price increase awards below the rate of inflation, or up to the annual rate of growth of output, or, even, modest tiered increments for a certain period, exceeding one year, but less than five years. In Austria, Portugal, Sweden, Switzerland, and UK, no statistically significant relationship between price levels and health care expenditures was found.

Country dummies

We included dummy variables in Austria, France, Germany, Sweden and the UK, in order to capture the effect of one-off major changes in macroeconomic and/or health care policy. The econometric analysis returned the following results on these variables: in France, Germany and Sweden. The dummies were not significantly associated with the dependent variable. In Austria, there was limited evidence of the dummy being statistically significant and negatively associated with health care spending, whereas in the UK there was limited evidence of a positive significant association.

6.4.3 Conclusions of the AR(1) analysis

For a number of countries the hypothesis that national income, proxied by GDP (at least partly), explains variations in health expenditures is rejected. The relevant evidence is presented in table 6.1 where, in a simple regression over time, and with both aggregate and per capita figures expressed in national currencies and in constant terms, GDP fails to explain any significant variation in health expenditures in seven of the fourteen EU Member States. Furthermore, as the value of the income elasticity of demand for health care is significantly below unity, it is shown that health is not a luxury good, but a necessity. In summary, GDP, lagged GDP, GDP growth, lagged total consumption, number of medical doctors were shown to be non-important determinants of health care expenditures in most countries. By contrast, consumption, deficit levels, changes in deficit (reflecting, partly, changes in fiscal stance), technology, prices, and, to some extent, health system-related dummies, were significant predictors of health care expenditures in the majority of countries examined.

In addition to the above, a key finding is that models hold for some countries but break down in others. This is due to model specification, as well as model-related data problems, such as autocorrelation. This, in turn, shows that results can be country-specific and that placing all countries in one sample for the simple purpose of boosting the number of sample observations (and, by extension, the number of degrees of freedom), is problematic and may lead to spurious overall results.

Some of the results reported in tables 6.1, 6.2, and 6.4 still suffer from the presence of autocorrelation, despite the application of the AR(1) method. Some of the models frequently break down due to the persistence of autocorrelation in the residuals in Finland, Germany, USA, the Netherlands, and Spain. This explains why an alternative methodology may be essential in understanding the determinants of health care expenditures and, for that purpose, why the conduct of co-integration analysis may be an important tool in accounting for the short-term dynamics in our models. This will be pursued in the sections that follow.

6.5 The significance of Unit Root tests

6.5.1 The rationale behind testing for unit roots

Time series are often not stationary over time, exhibiting trends that are often due to factors that are unknown. For example the causal factors for economic growth are only partially understood. If the primary interest in the analysis of the time series data is the long-term trend, then it is important to build a model for the trend that contains the important covariates for the trend-generating mechanism. A series is said to be (weakly- or covariance-) stationary if the mean and auto-covariances of the series do not depend on time. The benchmark example of a non-stationary series is the so-called "random walk", described as follows:

$$y_t = y_{t-1} + \varepsilon_t \qquad (6.1)$$

where ϵt is a stationary random disturbance term. The series y has a constant forecast value, conditional on t, and the variance is increasing over time. The random walk is a difference stationary series since the first difference of y is stationary:

$$y_t - y_{t-1} = (1-L)y_t = \varepsilon_t \qquad (6.2)$$

A stationary time series is said to contain at least one unit root. Stationarity in a non-stationary time series can be achieved by differencing it as many times as it takes for it to become stationary. A difference stationary series is said to be integrated of order d, and is denoted as I(d), where d is the order of integration. The order of integration is the number of unit roots contained in the series, or the number of differencing operations it takes to make the series stationary. For the random walk above, there is one unit root, therefore the series is integrated of order one, or I(1). Similarly, a stationary series in levels is integrated of order zero, or I(0).

The significance of testing for stationarity lies in the fact that standard inference procedures do not apply to models and regressions containing an integrated dependent variable or integrated regressors. Therefore, it is important to check whether a series is stationary or not before using it in a regression. The formal method to test the stationarity of a series is the unit root test. Non-stationary variables need first to be differenced in order to achieve stationarity before a model can be run. This principle underlies the cointegration procedure, outlined in section 6.7 below.

6.5.2 Testing for Unit Roots: The Augmented Dickey-Fuller Test

Unit root tests are important in examining the stationarity of a time series (Fuller, 1976; Dickey, 1976; Dickey and Fuller, 1979; Engle and Granger, 1987). Stationarity is a matter of concern because in co-integration analysis an important question is whether the disturbance term in the co-integrating vector has a unit root[82]. Testing for the null hypothesis of no co-integration (or a unit root in the residuals) can be done by the Augmented Dickey Fuller (ADF) test, or by one of the other methods described in Engle and Granger (1987).

The ADF test consists of running a regression of the first difference of the series against the series lagged once, lagged difference terms, and optionally, a constant and a time trend. With two lagged difference terms, the regression is

$$\Delta yt = \beta 1yt\text{-}1 + \beta 2\Delta yt\text{-}1 + \beta 3\Delta yt\text{-}2 + \beta 4 + \beta 5t \qquad (6.3)$$

82 Other than this, stationarity is a matter of concern in two additional and important areas. First, a crucial question in the ARIMA modelling of a single time series is the number of times the series needs to be first differenced before an ARMA model is fit. Each unit root requires a first differencing operation. Second, stationarity of regressors is assumed in the derivation of standard inference procedures for regression models. Nonstationary regressors invalidate many standard results and require special treatment.

There are three choices in running the ADF test regression: first, whether to include a constant term in the regression; second, whether to include a linear time trend; and, third, how many lagged differences are to be included in the regression. The combination of these choices affects the critical values of the reported test statistic (McKinnon critical values), which in turn leads to acceptance or rejection of the null hypothesis (H_0) of a unit root. In each case the test for a unit root is a test on the coefficient of the lagged dependent variable (y_{t-1}) in the regression. If the coefficient is significantly different from zero the hypothesis that y contains a unit root is rejected and the hypothesis is accepted that y is stationary rather than integrated. The output of the ADF test consists of the t-statistic on the coefficient of the lagged test variable and critical values for the test of a zero coefficient. A large negative t-statistic rejects the hypothesis of a unit root and suggests that the series is stationary. Under the null hypothesis of a unit root, the reported t-statisitic does not have the standard t distribution. The critical values (McKinnon critical values) for testing the level of significance are presented in the test output. The reported critical values are chosen on the basis of the number of observations and the estimation option.

If the Dickey-Fuller t-statistic is smaller (in absolute value) than the reported critical values, the hypothesis of non-stationarity and the existence of a unit root cannot be rejected. In this case it will be concluded that the series may not be stationary in levels, or I(0). The next step up is to test whether the series is I(1) (integrated of order one) or integrated of a higher order, namely I(2), etc. A series is I(1) if its first difference does not contain a unit root. The ADF test can be repeated on the first difference of the series to test the hypothesis of integration of order 1 against higher orders.

6.6 Unit root tests: country-by country results

Bearing in mind the significance of unit root tests, all time series variables that were identified in the previous chapter, particularly those containing financial values, were tested for the presence of unit roots for each of the 13 identified countries. The results are shown in table **6.5** and table **6.6**. Table **6.5** presents the results of the Augmented Dickey Fuller (ADF) tests for all variables in levels, whereas table **6.6** presents ADF results for all variables in first differences.

With the exception of Portugal, the ADF test statistic for most other variables in the other 12 countries, is smaller than the reported McKinnon critical value at the 5% significance level (see table **6.5** – Notes for the McKinnon critical values). Consequently, the hypothesis of non-stationarity and the existence of a unit root cannot be rejected. Most series are therefore not stationary in levels [I(0)]. Having ascertained that most series are not I(0), we also tested whether the series were integrated in first differences, or I(1). As table **6.6** suggests, all variables[83] are integrated in first differences, since the ADF test statistic, was found to exceed the benchmark McKinnon critical values at 5% level (see table **6.6** - Notes for the McKinnon critical values).

The implications of the above are as follows: given that most of the variables in 12 of the 13 countries under examination are non-stationary in levels, conventional time series analysis (e.g. by using Ordinary Least Squares regression, or first order autoregressive procedure), would not capture the effect of trends and would therefore yield results of questionable robustness. The fact that the said time series were found to be I(1), implies that the analysis can be run in first differences. Relevant to this discussion is the use of co-integration analysis,

83 With the occasional exception of the price index for some countries.

namely the analysis incorporating variables, which are integrated of the same order. Section 7 below discusses the theoretical rationale underlying the use of co-integration analysis.

6.7 Co-integration

6.7.1 Rationale and application

The finding that many macro time series may contain a unit root has spurred development of the theory of non-stationary time series analysis. Two data time series, yt and xt , are said to be co-integrated of order, d, b, denoted as CI (d,b), if (i) they are both I(d); and (ii) there is a linear combination of them which is I (d - b) where b>0. The definition extends to several series (Engle and Granger, 1987). Essentially, this means that a group of non-stationary time series is co-integrated if there is a linear combination of them that is stationary; that is, the combination does not have a stochastic trend. The linear combination is called the co-integrating equation. Its normal interpretation is as a long-run equilibrium relationship between the variables in the model.

Suppose that xt is stationary in first differences. In other words it is integrated of order one, that is xt is I(1) and it can be expressed as

$$\Delta x_t = g_x + n_t \qquad (6.4)$$

where ηt is a stationary process with a mean of zero. If xt is in logarithms, as is usually the case, then gx is the average growth rate. Suppose also that yt is I(1), but with a mean of gy. Models of the form shown in equation (6.4) are not unreasonable for many macroeconomic time series as they are capable of reproducing the kind of evolutionary behaviour often observed in practice. Now suppose that there is a relationship between xt and yt, so that although they are both non-stationary, they tend to stay together in the long run. More specifically, they obey an equation of the form

$$y_t = v_o + vx_t + u_t \qquad \textbf{(6.5)}$$

where v_0 and v are parameters and ut is a zero mean stationary disturbance term. Again, if y_t and x_t are in logarithms, v can be interpreted as the long-run elasticity of y with respect to x.

A steady-state relationship between two I(1) variables was shown in equation (6.5) above. Thus the series yt and xt are CI (d, b) and it can be seen from (6.5) that setting the constant α equal to v yields a stationary linear combination zt , that is

$$z_t = y_t - vx_t = v_0 + u_t \qquad \textbf{(6.6)}$$

The above results suggest a two stage modeling strategy, which may be formalised as follows. Stage one: estimate the long-run parameters by running a static regression in levels; this is called the co-integrating regression. From this regression we can test the null hypothesis of no-co-integration by a Dickey-Fuller test for a unit root in the residuals, or by one of the other methods described in Engle and Granger (1987, p. 268); hence, we find a set of explanatory variables which form a co-integrating relationship with the dependent variable. Stage Two: we use the error correction term, zt, namely the residuals from the static regression, as an explanatory variable and estimate the short run dynamics; we test down to find a parsimonious dynamic structure. Applications of this strategy can be found in Engle and Granger (1987) and Hall (1986), among others.

The idea behind co-integration of two variables of any order, say d and b, can most easily be explained by considering the case of d = b = 1. Both series are non-stationary, and it is generally true that an arbitrary linear combination, $y_t - \alpha x_t$, where α is a constant, will also be non-stationary. However, because the series are co-integrated, there must be values of α such that $y_t - \alpha x_t$ is I(0) rather than I(1). In other words, the long-run movements cancel out. Thus, there is some kind of steady state relationship between the variables. In the case of $\alpha=1$, the steady-state relationship is such that y_t and x_t cannot drift too far apart.

Undoubtedly, co-integration analysis is very useful in terms of addressing the problem of data trends, but is not without drawbacks. The key criticism of co-integration analysis is bias in the initial estimation that carries over to the second step of the process. The OLS estimators, in what is termed the co-integrating regression, converge very rapidly to their limiting distributions, but these distributions are not normal and they depend strongly on the other parameters in the full model. There is, consequently, bias in the estimation. Available empirical evidence (Stock (1987); Banerjee et al. (1986)), suggests that the bias in the estimators could be substantial, particularly in very small samples. Thus inferences may be very misleading, and erroneous decisions could be made regarding variables to be included or restrictions to be imposed. At the second stage the bias carries over to the error correction term and may adversely affect the small-sample properties of the short run parameters. Given the size of our sample, we do not expect any significant bias in the initial estimation.

6.7.2 Co-integration (Johansen) tests and Vector Error Correction models (ECM)

Hypotheses about co-integration between two or more variables can be tested within a framework established by Johansen (1991). Given a group of non-stationary series, the Johansen procedure allows us to determine whether the series are co-integrated, and if they are, to identify the co-integrating (long-run equilibrium) relationships.

If there are N endogenous variables, each of which is first-order integrated (that is, each has a unit root or stochastic trend or random-walk element), there can be from zero to N-1 linearly independent co-integrating vectors. If there are none, the standard time series analysis such as vector autoregression (VAR) applies to the first differences of the data. Because there are N separate integrated elements driving the series, levels of the series do not appear in the VAR. If there is one co-integrating equation, the VAR will need an error correction term involving levels of the series, and this term will appear on the right-hand side of each of the VAR equations, which otherwise will be in first differences. Each additional co-integrating equation contributes another error correction term involving levels of the series on the right-hand side of each VAR equation. The Johansen tests can determine the number of co-integrating equations. This number is called the co-integrating rank.

If there are N co-integrating equations, it means that none of the series is actually integrated, and the VAR can be specified in terms of the levels of all of the series. If augmented Dickey-Fuller tests show that some of the series are integrated, but the Johansen tests show that the co-integrating rank is N, there is a contradiction. Some specification error might be responsible for this contradiction.

There is a sequence of nested models in this general framework. The most restricted model, with the smallest number of parameters, has no co-integrating equations. It is a VAR strictly in first differences. Each co-integrating equation adds the parameters associated with the term involving levels of the series which needs to be added to each equation. The Johansen test procedure computes the likelihood ratio statistic for each added co-integrating equation.

The time series undergoing testing may have means and deterministic trends as well as stochastic trends. Similarly, the co-integrating equations may have intercepts and deterministic trends. Johansen's framework considers five combinations of these ingredients:

- Series have means, but the co-integrating equations do not have intercepts;
- Series have means and the co-integrating equations have intercepts;
- Series have means and linear trends but the co-integrating equations have only intercepts;
- Series have means and linear trends and the co-integrating equations have intercepts and linear trends; or
- Series have means, linear, and quadratic trends but the co-integrating equations have only intercepts and linear trends.

These five cases are nested from the most restrictive to the least restrictive, given any particular co-integrating rank. There are two dimensions in which tests can be carried out within this framework. One can assume one of the five cases listed above, and carry out tests for the co-integrating rank. Alternatively, one can fix the rank and test which of the five cases describes the data (these tests are standard $\chi 2$ tests). Or, if one selects the option to summarize all five cases, then all possible combinations of rank and intercept-trend can be looked at.

6.8 Johansen tests and co-integrating equations for each country

The Johansen tests for each country are shown in tables 6.7 and 6.8. Table 6.7 provides the results of the Johansen procedure for each of the 13 countries under investigation, and for the same linear combination of regressors. This combination includes GDP, as a measure of national income, as well as prices, deficit, physician numbers and technology. By contrast, table 6.8 provides the results of the Johansen procedure for each of the 13 countries under investigation, and for the same linear combination of regressors, which includes Consumption, as a measure of national wealth, prices, deficit, physician numbers and technology. The key test statistic, which determines the existence or not of co-integrating relationships among the variables in question, is the likelihood ratio test (column 2, tables 6.7 and 6.8). If the value of the likelihood ratio test is above the 5% critical (test) value, which is reported in column 3 of tables 6.7 and 6.8, then this indicates the existence of a co-integrating relationship. The number of co-integrating relationships is also reported at the bottom of each country box and is highlighted in bold.

Examination of the results of the Johansen procedure indicate the existence of at least one co-integrating relationship among the variables in question. In all countries, but Portugal, the number of co-integrating relationships/vectors is greater than zero and smaller than or equal to N-1, where N is the number of endogenous variables. For Portugal, there are as many co-integrating vectors as there are endogenous variables, meaning that none of the series is actually integrated, and the relationship between the variables in question (the vector autoregression) can be specified in terms of the levels of all of the series. The results of the

Johansen procedure for Portugal, confirms what was already shown in tables 6.6 and 6.7 (namely there are no trends in the data series for this country). The implications of this are that the results of the AR(1) procedure, shown in tables 6.2 and 6.4, hold for Portugal.

The results of the Johansen procedure, and, before that, the ADF tests, have confirmed two very important issues that are critical to the analysis of the determinants of health care expenditures from a time-series perspective:

- First, that variables have trends in them, which means they are not integrated in levels, but in first differences; the existence of trends in model variables, makes the use of traditional time-series regression analysis (OLS or AR(1)) obsolete;
- Second, that there are co-integrating relationships between the variables in question, which effectively means that a co-integration analysis should be run.

As outlined in the previous section, co-integration analysis implies a two-stage modelling strategy: the first stage involves the estimation of long-run parameters by running a static regression in levels. We do this by finding a set of explanatory variables which form a co-integrating relationship with the dependent variable; this is called the co-integrating equation. For this purpose, the results of the Johansen procedure are quite instrumental in terms of identifying one such co-integrating relationship. The second stage, involves the use of the residuals from the previous stage (this is called the "error correction term" - ECT), as an explanatory variable in the estimation of the short-run dynamics of our model.

For the first stage of the analysis we have identified two such co-integrating relationships per country which, as the above section suggested, we ran in levels. The equations that were run were as follows:

LNHCE95 = α1LNGDP95 + α2PRICE + α3DEFICIT95 + α4PHYSICIAN + α5TECHNOLOGY (6.7)

And

LNHCE95 = α1LNC95 + α2PRICE + α3DEFICIT95 + α4PHYSICIAN + α5TECHNOLOGY (6.8)

Each of the two equations (one incorporating GDP and one incorporating Consumption) was run for 12 of the 13 countries under investigation, as Portugal was excluded from the co-integration analysis because its results were found to be robust under the AR(1) method. From these regressions we tested the null hypothesis of no-co-integration for a unit root in the residuals, by using the Dickey-Fuller test. The test was passed for all countries. The results of the co-integrating equations have been compiled and are shown in tables 6.9 and 6.10. Table 6.9 shows the co-integrating equation that includes GDP and a dependent variable and table 6.10, shows the results when Consumption is included as an independent variable in the analysis. All equations are severely affected by autocorrelation in the residuals, a desirable feature for the analysis that will ensue. From each of the above equations (24 in total) and for each country, we isolated the residuals (Error Correction Term), which we subsequently used explanatory variables in the co-integration analysis that follows in section 9 below.

6.9 Co-integrating equations for the determinants of health care expenditures for each country

This section presents and discusses the results of co-integration analysis that is pursued following the analysis performed in the previous four sections. Sections 5 and 6 highlighted the significance of unit root tests and, by using the ADF test for the existence of a unit root, showed that the majority of variables were integrated of order 1 [I(1)]. This necessitated the performance of co-integration analysis, the framework for which was laid out in section 7, whereas section 8 explained the importance of the Johansen procedure in co-integration and presented the relevant Johansen tests for our analysis. Section 8 also performed the first stage of co-integration analysis, namely, the identification of a co-integrating relationship between the dependent and the explanatory variables and the isolation of the error correction term, to be used as an explanatory variable in subsequent analysis.

The model that is run in this section has both short-term and long-term dynamics. The short-term dynamics are captured by the Error Correction Term, together with all other variables run in first differences. The results are presented in tables 6.11 and 6.12. Table 6.11, includes GDP as a regressor, whereas table 6.12, includes Consumption as an independent variable.

6.9.1. Comments on the empirical results[84]

The model tested for each of the 12 countries in the sample[85] is as follows:

D(logHEX) = f{D(logGDP), D(logGDP(-1)), D(PHRMPCT), D(PHRMPCT(-1)), D(PHEX), D(PHEX(-1)), D(PHYSICIAN), D(DEFICIT), ECT[86]} **(6.9)**

D(logHEX) = f{D(logC), D(logC(-1)), D(PHRMPCT), D(PHRMPCT(-1)), D(PHEX), D(PHEX(-1)), D(PHYSICIAN), D(DEFICIT), ECT} **(6.10)**

84 Variables and results are always expressed in first differences, as is standard practice in co-integration analysis.
85 With the exception of Portugal, for which, as was shown in previous sections, standard regression analysis yields robust results.
86 ECT is the error correction term, which in co-integration analysis, displays the short-term dynamics of the model. The error correction term is the residual term from the co-integrating regression and is included as an independent variable in the final co-integration model.

The model outlined in equation 6.9 contains GDP as a regressor, whereas the model outlined in equation 6.10 contains consumption as a regressor. The main trends as they emerge from tables 6.11 and 6.12 are summarised n the following paragraphs.

With regards to GDP (table 6.11), with the exception of Denmark, it proves to be a statistically significant variable and, therefore, an important determinant of aggregate health care expenditure. In the case of Austria, Belgium, Finland, Switzerland, and the USA, the value of the GDP coefficient is greater than or closely equal to unity, whereas in the case of France, Sweden, Germany, UK, the Netherlands, and Spain, the value of the GDP coefficient is significantly below unity. Whilst these results can be interpreted as confirming, at least in part, the original literature results of health care being a luxury, there are important factors at play that reduce their significance. First, the addition of GDP lagged once to the model, frequently boosts the overall performance of the variable. The absence of lagged GDP from the model often renders GDP non-significant. Second, on several occasions (Austria, the Netherlands, Switzerland, USA), the inclusion of the DEFICIT variable (both in first difference and in lagged first difference form) in the model boosts significantly the performance of GDP (wither in first difference or in lagged first difference form) and elevates the value of its coefficient to levels above unity, and the value of the lagged GDP variable to levels very close to unity. When the DEFICIT variable is absent (or it is expressed as a percentage change over the previous period[DEFPCT]), however, GDP is weak, significantly below unity and at times non-significant. This is less prominent in Germany, Belgium, although in both these cases the addition of the DEFICIT variable (whether the first difference of deficit levels or the percentage change over time) boost upwards the value of the GDP coefficient, without affecting its statistical significance. Third, autocorrelation in some of the models, still poses problems about the credibility of the results in some cases (the Netherlands, USA).

Consumption (either in first differences or in lagged first differences) is positively related to health care expenditures and statistically significant in all 12 countries of the sample. The value of its coefficient ranges from significantly below unity (Austria, Finland, Spain, Sweden, Switzerland), to consistently above unity (Germany, the Netherlands, UK), and on several occasions the value of the coefficient may change from below to above unity or vice versa, depending on the model available (Belgium, Denmark, France, USA). Of course, a value over unity does not imply that health care is a luxury. The consumption variable is not affected by inclusion or not of other macroeconomic variables such as the DEFICIT or the DEFPCT variables, at least not to the same extent as GDP is. Overall, it appears that consumption, as a proxy of individual overall wealth provides a more stable, powerful and robust explanatory variable of the variation in aggregate health care expenditure over time and across countries.

With the exception of Spain and Switzerland, all countries display robust and statistically significant results for the technology variable PHRMPCT. It is shown that the technology variable is an important predictor of the variation in health care expenditures in ten of the twelve countries in the sample (table 6.12). Frequently, PHRMPCT is significant not only in first differences but also in lagged first differences. In seven out of ten countries, the sign of the relationship between health expenditure and technology is positive (Austria, Denmark, Finland, France, Germany, the Netherlands, UK), whereas in three countries the relationship is negative (Belgium, Sweden, USA). The negative sign appears to be puzzling and counter-intuitive at first glance, since one would expect that technology should have a positive impact on health care spending for that relationship to be plausible. However, it should not be forgotten that the co-integration results shown in the table 6.12[87] show the relationship between the dependent variable and the independent variables in first differences and lagged first differences. A positive sign suggests co-movement of the health expenditure dependent variable and the technology variable. A negative sign, as in the cases of Belgium, Sweden, and the USA, suggests that as health expenditure in first differences declines over time, the impact of technology in first differences increases over time; in other words, the contribution of technology in the variation in health care expenditures over time is very strong in these three countries, compared with the remainder of the sample, where there is co-movement between technology and health spending. As a result, a negative sign is an indication of a strong effect of technology on health spending.

The price variable (PHEX) shows similar results to those of the technology variable, but in a smaller number of countries (Denmark, Finland, the Netherlands, Spain, Sweden, Switzerland, UK). In the case of the Netherlands and Switzerland the relationship between health spending and prices is positive, indicating and co-movement, whereas in the remainder of the above cases, the relationship is negative. The positive sign indicates that prices in first differences[88] move faster than health expenditure over time; this indicates a strong price effect on health care expenditures. The negative sign, by contrast, indicates that prices in first differences (or lagged first differences) move slower than health expenditure over time; this indicates a weak price effect, which by implication means that volume (of goods or/and

87 We mostly use table 6.12 to report and comment on results, as table 6.11 explores co-integration results with GDP as an independent variable. We have commented extensively about the use of GDP as an independent variable in this thesis and the use of GDP in statistical analysis is done for expositional purposes only, therefore, in principle, table 6.11 serves to highlight and compare its performance with the empirical literature. Nevertheless, even in the case of the models presented in table 6.11, the results with regards to variables other than GDP are similar to those shown in table 6.12.

88 Or, indeed, also in lagged first differences (see table 6.12).

services) may be a stronger factor. In any case, there is a price effect which contributes significantly to the variation in health care expenditures.

The impact of the medical profession has produced mixed results, which, overall, cast doubt over the robustness of the empirical results that other studies have produced to date. In six of the twelve countries in the sample, the PHYSICIAN variable has no effect whatsoever on health expenditure over time (Austria, Belgium, Denmark, France, Spain, USA). In the remaining of the cases, the relationship is negative (Finland, Germany, the Netherlands, Switzerland), and, therefore, has the opposite sign than expected. In Sweden and the UK, the relationship between health spending and physicians is positive, as expected. In sum, the results are rather inconclusive for a single picture to emerge with regards to the impact of the medical profession on health care expenditure.

Finally, the DEFICIT variable is statistically significant with a negative sign in six of the twelve countries (Austria, Denmark, France, Sweden, UK, and USA) and has a positive sign in Spain (table 6.12). The above results are robust and highlight the relative importance of macroeconomic variables in explaining part of the variation in health care expenditures over time.

6.10 Overall conclusions

This chapter attempted an empirical investigation of the determinants of health care expenditures, by pursuing two alternative methodologies, firstly, the use of the first order autoregressive procedure, in lieu of ordinary least squares, with a view to doing away with autocorrelation found in the residuals of some of the models, and, secondly, co-integration analysis, in view of persistence of autocorrelation in some countries and with a view to determining the short-run dynamics of each model.

The findings can be summarised as follows:

First, the importance of GDP as the (or one of the) most important factor in explaining the variation in health care expenditures, either in levels, or in lagged terms, across countries has been grossly exaggerated. Its statistical significance in dozens of published studies may be due to model selection bias or conversion factor bias. The evidence presented in this chapter shows quite clearly, and by using alternative methodologies, that GDP is often an irrelevant factor. The same holds for the value of its coefficient and the extent to which it leads to the conclusion that health care is a luxury good. It has been shown that results vary by country with the value of the GDP coefficient significantly lower than unity being the rule rather then exception.

Second, the autocorrelation correction method, and, more importantly, co-integration analysis has confirmed our hypothesis that total consumption (as a proxy for total income) is an important predictor of the variation in health care expenditures across countries and over time, whether in level terms, or in first differences, or in lagged terms. The value of the consumption coefficient exceeds unity at times, but this cannot lend support to the argument that health care is a luxury good for the simple reason that micro-foundations of economic theory cannot be used to explain findings at the macroeconomic level, as was discussed in chapter 4.

Third, the evidence supports the hypothesis that there exists a link between the health economy and the macroeconomy. Macroeconomic variables, such as the fiscal deficit have been an important predictor of health care expenditures in many countries and across health care systems, leading to the conclusion that there is a feedback mechanism from the former to the latter. Some caution should nevertheless be used when interpreting these results because of the relatively high correlation between aggregate variables. In any case, the empirical evidence has produced robust results across a number of countries.

Fourth, our technology and price variables have produced solid results across all countries and health care systems, indicating the direct strong link between health care expenditure on the one side and health care technology and prices of health care goods on the other. This indicates that the latter are strong drivers of the former, and, as co-integration analysis has shown, in a number of countries the technology and/or price effect is very powerful indeed and contributes significantly to the outcome of policy interventions. Indeed, this implies that cost containment may be ineffective, unless targeted at factors that influence the consumption of technology or factors that contain growth in prices.

Fifth, the evidence presented in this chapter has failed to show any significant direct impact of the medical profession on health care expenditures. This comes against evidence published to date suggesting that the number of physicians in itself is a predictor of health care expenditures. By contrast, our hypothesis has been and continues to be that the number of physicians in determining health care costs is largely irrelevant and that what actually matters is what physicians authorise on behalf of their patients. The latter we were able to show through the technology and price variables.

Finally, and above everything, the empirical evidence presented in this chapter suggests that despite the similarities in the some of the results, common patterns across countries may be difficult to obtain. For instance, we have shown that the impact of the same variable may differ by country. In some sample countries, the same variable has a significant effect, in others not. In some countries the same variable has a significant impact in levels or in first differences, in others only in lagged terms. This highlights differences in health systems, regulatory and other practices, focus of attention by decision-makers, as well as the uniqueness in endogenous system dynamics. The differences across countries also confirm our initial critique of the empirical literature to date that placing countries together and treating them as identical is a dangerous oversimplification of reality, which, in addition, does not offer any policy insights.

Table 6-1 Simple regression results of Health Expenditure on GDP accounting for serial correlation

VARIABLES	Countries												
	Germany	Austria	Belgium	Netherlands	France	UK	Sweden	Denmark	Spain	Portugal	Switzerland	USA	Finland
C	3.388 (1.892)	-8.280 (-2.007)	-8.352 (-2.182)	-7.050 (-3.071)	5.322 (2.382)	6.923 (4.014)	8.068 (3.403)	10.987 (1.268)	-18.733 (-6.321)	1.903 (0.423)	4.948 (1.749)	-3.149 (-1.217)	-1.301 (-0.498)
LNGDP95	0.358 (1.998)	1.446 (4.092)	1.391 (4.640)	-1.390 (5.999)	0.230 (1.123)	-0.170 (-0.854)	0.0283 (0.137)	-0.241 (-0.320)	2.101 (9.548)	0.260 (0.691)	0.185 (0.675)	1.029 (3.825)	0.829 (3.411)
PERIOD	0.016 (0.965)				0.078 (5.530)	0.562E- 01 (3.678)	0.100 (6.446)	0.0876 (2.031)		0.874 (3.732)	0.111 (4.976)		
PERIOD SQ	0.666E - 02 (3.801)				-0.016 (-1.798)	-0.899E - 03 (-0.587)	-0.0017 (-1.221)	-0.00112 (-0.253)		-0.534E–01 (-3.140)	-0.401E - 02 (-1.905)		
PERIOD CU	-0.346E - 03 (-4.818)				0.204E - 04 (0.600)	0.177E- 04 (0.285)	-0.338E - 04 (-0.615)	-0.623E -05 (-0.035)		0.147E- 02 (2.788)	0.867E- 04 (1.038)		
PERIOD 4	0.488E - 05 (5.078)				-0.135E - 06 (-0.295)	-0.146E - 06 (0.176)	0.863E- 06 (1.178)	0.138E -06 (0.057)		-0.148E-04 (-2.533)	-0.720E- 06 (-0.648)		
Y6567		0.597E- 02 (0.108)	0.799E - 01 (1.801)	0.538E- 01 (1.544)					0.158 (3.255)			0.540E- 01 (1.324)	0.209 (3.986)
Y6870		0.345E - 01 (0.375)	0.425E - 01 (0.558)	0.166 (2.708)					0.180 (2.362)			0.185 (3.374)	0.333 (4.601)
Y7173		-0.516E - 01 (-0.352)	0.643 – E01 (0.546)	0.322 (3.839)					0.252 (2.360)			0.272 (3.998)	0.386 (3.641)
Y7476		0.140 (0.779)	0.276 (1.898)	0.401 (4.026)					0.264 (2.009)			0.361 (4.767)	0.464 (3.676)

	Countries												
	Germany	Austria	Belgium	Netherlands	France	UK	Sweden	Denmark	Spain	Portugal	Switzerland	USA	Finland
Y7779		0.230 (1.088)	0.443 (2.697)	0.408 (3.608)					0.350 (2.549)			0.408 (4.184)	0.542 (4.064)
Y8082		0.127 (0.543)	0.452 (2.485)	0.481 (4.224)					0.378 (2.729)			0.516 (5.344)	0.546 (3.415)
Y8385		0.360E - 01 (0.144)	0.501 (2.660)	0.464 (3.878)					0.349 (2.403)			0.602 (5.530)	0.614 (3.483)
Y8688		0.821E - 01 (0.305)	0.494 (2.407)	0.437 (3.275)					0.265 (1.606)			0.658 (5.096)	0.681 (3.470)
Y8991		O.646E - 01 (0.214)	0.472 (2.014)	0.446 (2.921)					0.277 (1.444)			0.788 (5.639)	0.779 (3.688)
Y9294		0.141 (0.452)	0.527 (2.199)	0.488 (3.016)					0.336 (1.696)			0.899 (6.235)	0.816 (4.275)
Y9597		0.140 (0.426)	0.467 (1.841)	0.437 (2.449)					0.257 (1.217)			0.891 (5.366)	0.727 (3.382)
R^2	0.996	0.992	0.995	0.997	0.999	0.996	0.996	0.970	0.998	0.987	0.994	0.996	0.992
Adj R^2	0.995	0.987	0.993	0.995	0.997	0.995	0.996	0.965	0.996	0.984	0.994	0.994	0.987
F	1524.48	225.69	419.72	613.40	5146.64	1376.26	1607.13	196.69	775..67	326.13	1179.57	503.16	229.38
RSS	0.028	0.068	0.050	0.240	0.009	0.021	0.171	0.197	0.040	0.089	0.037	0.031	0.065
DW	1.804	2.168	2.276	2.307	2.058	1.748	1.660	1.924	2.126	1.781	1.729	2.355	1.946

Table 6-2 Determinants of Health Care Expenditures – Results of AR(1) method with GDP as predictor of health spending

Austria						
VARIABLES	MODELS					
	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	-4.424 (-0.755)	-3.373 (0.575)	-11.012 (1.504)	-5.023 (-0.813)	-0.407 (-0.068)	-10.093 (-1.258)
LNGDP95	0.940 (1.780)		0.808 (1.528)	0.991 (1.786)		0.936 (1.676)
DEFPCT	-0.0323 (-4.161)	-0.0296 (-3.981)	-0.0353 (-4.511)	-0.0250 (-3.166)	-0.0215 (-2.752)	-0.0266 (-3.303)
SHARE	0.173 (4.046)	0.173 (3.858)	0.145 (3.159)	0.147 (3.005)	0.163 (3.185)	0.124 (2.287)
PHYSICIAN	-0.0836 (-0.383)	0.0338 (0.148)	0.0162 (0.071)	-0.0538 (-0.252)	0.0344 (0.151)	0.0174 (0.077)
PHRMPCT	0.00196 (1.447)	0.00239 (1.715)	0.00247 (1.791)			
LGLNGDP		0.836 (1.599)	0.720 (1.395)		0.573 (1.070)	0.509 (0.983)
PHEX				0.694 (1.104)	0.478 (0.757)	0.716 (1.136)
PERIOD	-0.0155 (-0.590)	-0.00465 (-0.197)	-0.0326 (-1.161)	-0.0221 (-0.724)	0.00272 (0.104)	-0.0352 (-1.062)
PERIODSQ	0.000686 (0.808)	0.000243 (0.276)	0.000473 (0.566)	0.000574 (0.623)	0.000110 (0.013)	0.000405 (0.434)
PERIODCU	-0.000002 (-0.118)	0.000001 (0.082)	0.000002 (0.176)	-0.000002 (-0.161)	0.0000002 (0.013)	0.0000008 (0.055)
R^2	0.994	0.994	0.994	0.994	0.993	0.994
Adj R^2	0.992	0.992	0.993	0.992	0.991	0.992
F	610.76	577.50	556.49	555.30	505.60	485.19
DW	1.839	1.837	1.835	1.746	1.753	1.727
Mean	9.473	9.473	9.473	9.473	9.473	9.473
S.D	0.480	0.480	0.480	0.480	0.480	0.480
RSS	0.044	0.046	0.042	0.049	0.053	0.048
Log-L	69.510	68.507	70.628	67.806	66.129	68.174

Table 6.2 (continued)						
Belgium						
	MODELS					
VARIABLES	**EQ1**	**EQ2**	**EQ3**	**EQ4**	**EQ5**	**EQ6**
Constant	19.212 (3.684)	6.944 (1.311)	20.573 (2.793)	13.000 (2.289)	3.402 (0.717)	8.238 (1.059)
LNGDP95	-1.076 (-2.463)		-1.076 (-2.405)	-0.408 (-0.886)		-0.361 (-0.773)
DEFPCT	0.00343 (0.652)	-0.00363 (-0.679)	0.00302 (0.550)	-0.00302 (-0.479)	-0.00435 (-0.763)	-0.00194 (-0.299)
SHARE	0.198 (4.240)	0.133 2.411	0.204 (3.560)	0.112 (1.574)	0.0702 (1.028)	0.0924 (1.232)
PHYSICIAN	-0.0392 (-0.394)	-0.00797 (-0.071)	-0.0428 (-0.422)	0.0251 (0.260)	0.0471 (0.486)	0.0352 (0.358)
PHRMPCT	0.00109 (0.800)	0.00121 (0.756)	0.00121 (0.851)			
LGLNGDP		-0.0414 (-0.092)	-0.114 (-0.285)		0.382 (0.987)	0.346 (0.888)
PHEX				0.0652 (0.168)	0.164 (0.437)	0.0890 (0.227)
PERIOD	0.290 (6.848)	0.230 (4.877)	0.296 (5.909)	0.0715 (2.245)	0.0392 (1.302)	0.0553 (1.508)
PERIODSQ	-0.00786 (-4.674)	-0.00677 (-3.412)	-0.00799 (-4.352)	0.000568 (0.364)	0.000893 (0.575)	0.000783 (0.496)
PERIODCU	0.00007 (2.803)	0.00006 (2.222)	0.00007 (2.685)	-0.00004 (-1.275)	-0.00003 (-1.234)	-0.00004 (-1.292)
R^2	0.995	0.993	0.995	0.992	0.933	0.993
Adj R^2	0.993	0.990	0.992	0.990	0.991	0.991
F	439.33	325.97	383.51	430.52	480.27	422.31
DW	1.713	1.670	1.677	1.506	1.574	1.554
Mean	10.701	10.701	10.701	10.428	10.428	10.428
S.D	0.335	0.335	0.335	0.565	0.565	0.565
RSS	0.015	0.020	0.014	0.087	0.078	0.076
Log-L	63.008	59.003	63.532	57.377	59.330	59.811

Table 6.2 (continued)						
Denmark						
VARIABLES	MODELS					
	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	3.053 (0.222)	-2.820 (-0.266)	-9.866 (-0.507)	4.273 (2.433)	4.546 (1.578)	3.438 (1.168)
LNGDP95	0.232 (0.204)		0.509 (0.433)	0.194 (1.141)		0.180 (1.036)
DEFPCT	-0.00900 (-0.884)	-0.0113 (-1.339)	-0.0151 (-1.279)	0.00323 (2.704)	0.00314 (1.470)	0.00262 (1.254)
SHARE	0.235 (0.763)	0.128 (0.395)	0.117 (0.356)	-0.0488 (-2.276)	-0.0714 (-2.091)	-0.0584 (-1.688)
PHYSICIAN	0.00351 (0.018)	0.0143 (0.074)	0.00830 (0.042)	0.00959 (0.386)	0.0133 (0.510)	0.0107 (0.431)
PHRMPCT	0.00446 (1.532)	0.00427 (1.503)	0.00389 (1.301)			
LGLNGDP		0.845 (0.859)	0.961 (0.927)		0.165 (0.594)	0.0957 (0.353)
PHEX				2.189 (12.527)	2.130 (11.231)	2.170 (11.947)
PERIOD	0.0446 (0.664)	0.0386 (0.659)	0.0208 (0.298)	0.165 (3.158)	0.208 (6.082)	0.166 (3.196)
PERIODSQ	-0.00308 (-0.729)	-0.00189 (-0.434)	-0.00144 (-0.326)	-0.00603 (-3.352)	-0.00724 (-5.410)	-0.00596 (-3.316)
PERIODCU	0.00006 (0.621)	0.00003 (0.289)	0.00002 (0.205)	0.0007 (3.466)	0.00008 (4.559)	0.00007 (3.190)
R^2	0.957	0.959	0.960	0.986	0.986	0.987
Adj R^2	0.941	0.945	0.943	0.974	0.973	0.972
F	60.92	65.05	56.02	79.87	79.07	67.39
DW	1.816	1.862	1.851	2.920	2.881	2.918
Mean	9.337	9.337	9.337	9.592	9.592	9.592
S.D	0.318	0.318	0.318	0.057	0.057	0.057
RSS	0.131	0.123	0.122	0.001	0.001	0.001
Log-L	40.703	41.678	41.899	64.869	64.781	65.453

Table 6.2 (continued)						
France						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	4.746 (1.833)	5.867 (2.783)	4.459 (1.583)	4.278 (1.364)	4.895 (2.124)	3.738 (1.140)
LNGDP95	0.256 (1.051)		0.216 (0.767)	0.247 (0.807)		0.175 (0.505)
DEFPCT	-0.00653 (-1.783)	-0.00439 (-1.744)	-0.00647 (-1.736)	-0.00605 (-1.424)	-0.00427 (-1.534)	-0.00592 (-1.368)
SHARE	0.0329 (2.449)	0.0354 (2.500)	0.0310 (2.008)	0.0212 (1.381)	0.0225 (1.642)	0.0183 (1.131)
PHYSICIAN	-0.0473 (-0.655)	-0.0571 (-0.758)	-0.0400 (-0.509)	0.0263 (0.401)	0.0205 (0.327)	0.0331 (0.485)
PHRMPCT	0.000938 (1.719)	0.000970 (1.750)	0.000911 (1.617)			
LGLNGDP		0.153 (0.759)	0.0682 (0.296)		0.187 (0.851)	0.126 (0.498)
PHEX				0.499 (1.634)	0.528 (1.853)	0.477 (1.550)
PERIOD	0.0568 (4.667)	0.0618 (6.305)	0.0560 (4.434)	0.0580 (4.309)	0.0601 (5.215)	0.056224 (4.028)
PERIODSQ	-0.000265 (-0.483)	-0.000343 (-0.606)	-0.000300 (-0.521)	-0.000175 (-0.242)	-0.000161 (-0.227)	-0.000223 (-0.306)
PERIODCU	-0.000008 (-0.897)	-0.000008 (-0.780)	-0.000007 (-0.737)	-0.00001 (-0.807)	-0.00001 (-0.898)	-0.000009 (-0.686)
R^2	0.999	0.999	0.999	0.999	0.999	0.999
Adj R^2	0.999	0.999	0.999	0.999	0.999	0.999
F	4162.10	4044.74	3555.18	4628.42	4652.83	4020.03
DW	2.128	2.138	2.139	2.030	2.060	2.050
Mean	8.943	8.943	8.943	8.889	8.889	8.889
S.D	0.418	0.418	0.418	0.466	0.466	0.466
RSS	0.004	0.004	0.004	0.005	0.005	0.005
Log-L	104.221	103.735	104.238	106.946	107.040	107.208

Table 6.2 (continued)						
Finland						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	6.228 (1.733)	1.951 (0.693)	2.934 (0.793)	4.679 (1.736)	1.228 (0.600)	0.794 (0.283)
LNGDP95	0.157 (0.495)		-0.154 (-0.467)	0.220 (0.937)		0.0518 (0.235)
DEFPCT	0.000859 (0.191)	-0.00206 (-0.576)	-0.00103 (-0.238)	0.00190 (0.523)	-0.000278 (-0.098)	-0.000702 (-0.206)
SHARE	-0.0704 (-0.615)	-0.0700 (-0.710)	-0.0791 (-0.762)	-0.0789 (-1.071)	-0.0978 (-1.539)	-0.0957 (1.459)
PHYSICIAN	0.0217 (0.148)	0.0977 (0.721)	0.118 (0.805)	0.108 (0.979)	0.186 (1.854)	0.182 (1.761)
PHRMPCT	0.00466 (2.853)	0.00326 (2.077)	0.00293 (1.679)			
LGLNGDP		0.567 (2.195)	0.636 (2.153)		0.555 (3.002)	0.541 (2.765)
PHEX				0.872 (3.303)	0.855 (3.758)	0.867 (3.646)
PERIOD	0.0998 (1.086)	0.0631 (0.785)	0.0661 (0.796)	0.126 (5.375)	0.118 (6.075)	0.116 (5.474)
PERIODSQ	-0.00114 (-0.355)	-0.000508 (-0.184)	-0.000507 (-0.181)	-0.00250 (-2.877)	-0.00286 (-3.785)	-0.00284 (-3.664)
PERIODCU	-0.000004 (-0.089)	-0.000008 (-0.219)	-0.000009 (-0.230)	0.00001 (0.674)	0.00002 (1.395)	0.00002 (1.355)
R^2	0.981	0.989	0.991	0.994	0.996	0.996
Adj R^2	0.973	0.984	0.986	0.993	0.995	0.995
F	118.94	199.81	207.24	583.10	820.98	727.04
DW	1.058	1.487	1.570	1.392	1.825	1.784
Mean	8.784	8.784	8.784	8.560	8.560	8.560
S.D	0.273	0.273	0.273	0.473	0.473	0.473
RSS	0.036	0.989	0.018	0.045	0.032	0.996
Log-L	51.027	57.928	60.754	69.249	75.378	75.988

Table 6.2 (continued)						
Germany						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	3.638 (2.194)	6.589 (4.204)	4.479 (2.139)	-0.00973 (-0.004)	7.489 (3.113)	1.255 (0.385)
LNGDP95	0.255 (1.441)		0.275 (1.518)	0.627 (2.695)		0.612 (2.583)
DEFPCT	-0.00253 (-1.110)	-0.000724 (-0.352)	-0.00259 (-1.130)	-0.00537 (-1.790)	-0.00256 (-0.820)	-0.00535 (-1.768)
SHARE	-0.0257 (-1.146)	-0.0280 (-1.210)	-0.0250 (-1.079)	0.0696 (1.828)	0.0881 (2.110)	0.0692 (1.781)
PHYSICIAN	0.0632 (0.530)	0.172 (1.576)	0.720 (0.594)	-0.184 (-1.315)	-0.0197 (-0.137)	-0.172 (-1.199)
PHRMPCT	0.00228 (3.065)	0.00259 (3.300)	0.00206 (2.501)			
LGLNGDP		-0.0608 (-0.382)	-0.105 (-0.673)		-0.173 (-0.746)	-0.111 (-0.527)
PHEX				0.165 (0.475)	0.194 (0.497)	0.140 (0.394)
PERIOD	0.240 (6.039)	0.264 (6.948)	0.240 (5.906)	0.0301 (1.299)	0.0538 (2.012)	0.0352 (1.388)
PERIODSQ	-0.00931 (-4.838)	-0.0103 (-5.517)	-0.00925 (-4.693)	0.000586 (0.513)	-0.00001 (-0.012)	0.000508 (0.433)
PERIODCU	0.000122 (4.569)	0.000134 (5.030)	0.000120 (4.380)	-0.00001 (-0.882)	-0.0002 (-0.693)	-0.00002 (-0.875)
R^2	0.994	0.994	0.994	0.994	0.992	0.994
Adj R^2	0.992	0.991	0.992	0.992	0.990	0.992
F	426.3	403.3	362.9	605.2	440.9	519.93
DW	1.731	1.866	1.730	1.506	1.544	1.450
Mean	8.144	8.144	8.144	7.914	7. 914	7.914
S.D	0.216	0.216	0.216	0.452	0.452	0.452
RSS	0.006	0.006	0.006	0.093	0.054	0.039
Log-L	74.395	73.651	74.585	71.472	65.808	71.537

Table 6.2 (continued)

Netherlands

VARIABLES	MODELS					
	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	3.126 (0.961)	-2.090 (-0.778)	-4.169 (-1.152)	-0.568 (-0.213)	0.932 (0.331)	-4.562 (-1.401)
LNGDP95	0.293 (0.860)		0.263 (0.883)	0.773 (2.839)		0.702 (2.618)
DEFPCT	-0.00552 (-0.989)	-0.00514 (-1.150)	-0.00683 (-1.397)	-0.00522 (-1.145)	-0.000341 (-0.077)	-0.00491 (-1.106)
SHARE	0.0788 (0.736)	-0.0679 (-0.606)	-0.0858 (-0.750)	-0.0967 (-1.065)	-0.116 (-1.175)	-0.143 (1.583)
PHYSICIAN	0.0675 (0.610)	0.0335 (0.354)	0.00368 (0.036)	-0.134 (-1.401)	-0.105 (-1.050)	-0.151 (-1.624)
PHRMPCT	0.000174 (0.146)	-0.00102 (-0.888)	-0.00112 (-0.968)			
LGLNGDP		0.979 (2.973)	0.947 (2.842)		0.651 (2.123)	0.536 (1.871)
PHEX				0.971 (5.111)	0.767 (3.495)	0.807 (4.097)
PERIOD	0.0768 (1.435)	0.0319 (0.763)	0.0218 (0.495)	0.0704 (3.857)	0.0796 (4.194)	0.0494 (2.409)
PERIODSQ	-0.00321 (-1.378)	-0.000485 (-0.238)	0.00006 (0.030)	-0.00185 (-1.993)	-0.00189 (-1.747)	-0.000679 (-0.630)
PERIODCU	0.00005 (1.374)	0.000004 (0.132)	-0.000005 (-0.150)	0.00002 (1.483)	0.00002 (1.198)	0.000005 (0.260)
R^2	0.987	0.993	0.993	0.998	0.998	0.998
Adj R^2	0.981	0.990	0.989	0.997	0.997	0.997
F	157.31	284.96	237.88	1449.24	1604.63	1543.91
DW	1.651	1.793	1.657	1.556	1.648	1.560
Mean	7.945	7.945	7.945	7.674	7.674	7.674
S.D	0.187	0.187	0.187	0.469	0.469	0.469
RSS	0.011	0.006	0.006	0.018	0.016	0.014
Log-L	61.629	68.984	69.006	85.820	87.649	89.750

Table 6.2 (continued)						
Portugal						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	1.673 (0.155)	11.715 (0.950)	7.002 (0.617)	-3.454 (-0.781)	5.508 (1.730)	-6.180 (-1.217)
LNGDP95	0.706 (1.296)		1.549 (2.210)	0.888 (2.651)		0.918 (2.746)
DEFPCT	0.00253 (0.554)	0.00424 (0.965)	0.000775 (0.146)	0.000687 (0.137)	0.00387 (0.838)	0.000766 (0.153)
SHARE	-0.233 (-0.985)	-0.298 (-1.043)	-0.446 (-1.758)	-0.0176 (-0.153)	0.0918 (0.555)	0.0431 (0.338)
PHYSICIAN	-0.0825 (-0.179)	0.106 0.230	-0.188 (-0.371)	-0.683 (-3.142)	-0.680 (-2.663)	-0.653 (-2.994)
PHRMPCT	0.000106 (0.074)	-0.000184 -0.124	0.000139 (0.086)			
LGLNGDP		0.166 (0.269)	-1.085 (-1.535)		0.0938 (0.870)	0.104 (1.055)
PHEX				-0.145 (-1.253)	-0.0181 (-0.151)	-0.154 (-1.331)
PERIOD	0.0946 (0.225)	-0.187 (-0.423)	0.0351 (0.082)	0.284 (3.657)	0.416 (3.592)	0.340 (3.637)
PERIODSQ	0.00165 (0.098)	0.0129 (0.689)	0.00765 (0.443)	-0.00578 (-1.151)	-0.0115 (-1.573)	-0.00908 (-1.544)
PERIODCU	-0.00004 (-0.181)	-0.000171 (-0.742)	-0.000122 (-0.583)	0.00005 0.688	0.000122 (1.181)	0.00009 (1.333)
R^2	0.981	0.978	0.984	0.990	0.987	0.991
Adj R^2	0.967	0.962	0.969	0.986	0.982	0.987
F	71.61	60.49	67.06	247.33	183.91	221.29
DW	1.780	1.670	1.998	1.959	1.822	1.998
Mean	11.350	11.350	11.350	11.107	11.107	11.107
S.D	0.304	0.304	0.304	0.498	0.498	0.498
RSS	0.333	0.040	0.029	0.064	0.085	0.060
Log-L	35.644	33.991	37.094	45.486	41.384	46.327

Table 6.2 (continued)			
Spain			
	MODELS		
VARIABLES	EQ1	EQ2	EQ3
Constant	-4.567 (-0.519)	-2.646 (-0.170)	11.599 (1.362)
LNGDP95	1.872 (3.706)		3.917 (4.309)
DEFPCT	-0.00834 (-1.218)	0.00293 (0.409)	-0.0152 (-2.556)
SHARE	-0.398 (-1.910)	-0.322 (-1.091)	-0.610 (-3.444)
PHYSICIAN	0.407 (2.092)	0.0322 (0.096)	1.083 (3.426)
PHRMPCT	0.000638 (0.494)	0.000798 (0.455)	0.00146 (1.206)
LGLNGDP		1.397 (1.928)	-2.375 (-2.541)
PHEX			
PERIOD	-0.827 (-2.755)	-0.367 (-0.591)	-1.957 (-3.964)
PERIODSQ	0.0293 (3.041)	0.0160 0.767	0.0661 (4.228)
PERIODCU	-0.000307 (-2.732)	-0.000179 (-0.763)	-0.000695 (-4.144)
R^2	0.966	0.993	0.998
Adj R^2	0.993	0.986	0.995
F	273.36	148.00	350.35
DW	1.820	1.600	2.553
Mean	11.531	11.531	11.531
S.D	0.242	0.242	0.242
RSS	0.003	0.006	0.002
Log-L	48.233	43.044	52.466

Table 6.2 (continued)						
Sweden						
	MODELS					
VARIABLES	**EQ1**	**EQ2**	**EQ3**	**EQ4**	**EQ5**	**EQ6**
Constant	14.971 (3.304)	7.027 (1.896)	12.918 (2.381)	12.597 (3.878)	9.125 (3.055)	12.809 (3.051)
LNGDP95	-0.566 (-1.415)		-0.582 (-1.431)	-0.359 (-1.240)		-0.358 (-1.202)
DEFPCT	0.00477 (2.059)	0.00198 (1.039)	0.00426 (1.729)	0.00354 (1.880)	0.00224 (1.294)	0.00359 (1.743)
SHARE	-0.0176 (-0.381)	-0.0365 (-0.747)	-0.0174 (-0.360)	-0.00247 (-0.058)	-0.0162 (-0.380)	-0.00244 (-0.056)
PHYSICIAN	-0.000485 (-0.005)	0.0235 (0.252)	-0.00666 (-0.070)	-0.0321 (-0.437)	-0.0229 (-0.307)	-0.0316 (-0.419)
PHRMPCT	-0.000212 (-0.290)	-0.00005 (-0.065)	-0.000154 (-0.211)			
LGLNGDP		0.141 (0.448)	0.194 (0.618)		-0.0433 (-0.169)	-0.0196 (-0.076)
PHEX				-0.0122 (-0.216)	-0.00933 (-0.161)	-0.0123 (-0.212)
PERIOD	0.151 (4.525)	0.130 (3.519)	0.147 (4.125)	0.121 (8.866)	0.110 (7.805)	0.122 (7.311)
PERIODSQ	-0.00393 (-2.525)	-0.00348 (-1.978)	-0.00391 (-2.353)	-0.00291 (-2.959)	-0.00252 (-2.557)	-0.00293 (-2.884)
PERIODCU	0.00003 (1.296)	0.00003 (0.994)	0.00003 (1.246)	0.00002 (1.097)	0.00002 (0.798)	0.00002 (1.083)
R^2	0.984	0.981	0.984	0.996	0.996	0.996
Adj R^2	0.977	0.972	0.975	0.995	0.994	0.995
F	136.88	114.32	115.06	782.26	760.96	712.10
DW	1.751	1.606	1.797	1.769	1.708	1.769
Mean	9.574	9.574	9.574	9.419	9.419	9.419
S.D	0.154	0.154	0.154	0.332	0.332	0.332
RSS	0.010	0.012	0.010	0.015	0.016	0.015
Log-L	68.323	65.934	68.340	85.480	84.999	86.579

Table 6.2 (continued)

Switzerland

VARIABLES	MODELS					
	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	8.902 (3.139)	7.492 (2.545)	8.051 (2.286)	6.686 (1.740)	3.393 (1.011)	3.624 (0.835)
LNGDP95	-0.0319 (-0.128)		-0.0804 (-0.289)	0.156 (0.462)		-0.0298 (-0.082)
DEFPCT	-0.00751 (-1.608)	-0.00701 (-1.417)	-0.00659 (-1.259)	-0.00555 (-0.924)	-0.00195 (-0.305)	-0.00182 (-0.273)
SHARE	-0.176 (-2.877)	-0.162 (-2.326)	-0.162 (-2.269)	-0.175 (-3.429)	-0.146 (-2.712)	-0.146 (-2.668)
PHYSICIAN	-0.174 (-1.312)	-0.150 (-1.223)	-0.168 (-1.229)	-0.267 (-1.401)	-0.200 (-1.228)	-0.208 (-1.111)
PHRMPCT	-0.00007 (-0.125)	-0.00007 (-0.134)	-0.00008 (-0.138)			
LGLNGDP		0.0871 (0.355)	0.118 (0.427)		0.435 (1.506)	0.445 (1.391)
PHEX				0.963 (1.915)	1.052 (2.309)	1.034 (2.024)
PERIOD	0.163 (3.070)	0.158 (2.978)	0.156 (2.781)	0.0986 (5.494)	0.0871 (5.506)	0.0881 (4.540)
PERIODSQ	-0.00295 (-1.548)	-0.00305 (-1.713)	-0.00292 (-1.490)	-0.000732 (-0.962)	-0.00103 (-1.319)	-0.00103 (-1.296)
PERIODCU	0.00002 (0.728)	0.00002 (0.920)	0.00002 (0.757)	-0.000009 (-0.584)	0.0000006 (0.039)	0.0000006 (0.034)
R^2	0.995	0.995	0.995	0.997	0.997	0.997
Adj R^2	0.993	0.993	0.993	0.996	0.996	0.996
F	454.48	455.62	384.80	1026.47	1084.73	929.92
DW	1.754	1.751	1.751	1.938	1.904	1.905
Mean	8.194	8.194	8.194	7.976	7.976	7.976
S.D	0.257	0.257	0.257	0.456	0.456	0.456
RSS	0.008	0.008	0.008	0.024	0.023	0.023
Log-L	70.567	70.601	70.682	80.643	81.634	81.661

Table 6.2 (continued)

United Kingdom

VARIABLES	MODELS			
		EQ1	EQ2	EQ3
Constant		3.986 (2.438)	1.718 (1.369)	2.013 (1.380)
LNGDP95		0.142 (0.782)		-0.0785 (-0.413)
DEFPCT		-0.00791 (-3.392)	-0.0105 (-5.327)	-0.0104 (-5.076)
SHARE		0.0212 (0.707)	-0.00426 (-0.171)	-0.00652 (-0.252)
PHYSICIAN		-0.0193 (-0.224)	0.0136 (0.178)	0.0111 (0.143)
PHRMPCT				
LGLNGDP			0.436 (2.902)	0.484 (0.192)
PHEX		-0.00709 (-0.193)	-0.0203 (-0.616)	-0.0191 (-0.567)
PERIOD		0.0420 (4.724)	0.0368 (5.865)	0.0382 (5.296)
PERIODSQ		-0.000625 (-2.066)	-0.000464 (-1.973)	-0.000477 (-1.978)
PERIODCU		0.000009 (1.519)	0.000005 (1.154)	0.000005 (1.139)
R^2		0.998	0.998	0.998
Adj R^2		0.997	0.998	0.998
F		1507.00	1899.99	1636.99
DW		1.881	1.966	1.973
Mean		6.181	6.181	6.181
S.D		0.376	0.376	0.376
RSS		0.011	0.009	0.009
Log-L		94.487	98.650	98.767

Table 6.2 (continued)

United States

VARIABLES	MODELS					
	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	6.126 (4.219)	7.547 (6.432)	6.264 (3.476)	5.995 (4.401)	6.479 (5.528)	6.121 (3.599)
LNGDP95	0.145 (0.948)		0.147 (0.939)	0.0445 (0.290)		0.0462 (0.294)
DEFPCT	-0.00235 (-1.023)	-0.000833 (-0.466)	-0.00230 (-0.969)	0.000754 (0.294)	0.00134 (0.741)	0.000791 (0.301)
SHARE	-0.0778 (-3.224)	-0.0756 (-3.110)	-0.0781 (-3.159)	-0.0261 (-0.852)	-0.0234 (-0.809)	-0.0265 (-0.845)
PHYSICIAN	-0.0756 (-1.780)	-0.0737 (-1.677)	-0.0746 (-1.699)	-0.0380 (-0.928)	-0.0356 (-0.868)	-0.0372 (-0.885)
PHRMPCT	0.00158 (1.389)	0.0166 1.439	0.00157 (1.352)			
LGLNGDP		-0.00645 (-0.054)	-0.0161 (-0.135)		-0.0116 (-0.106)	-0.0144 (-0.129)
PHEX				0.852 (2.295)	0.887 (2.543)	0.849 (2.241)
PERIOD	0.0704 (8.615)	0.0757 (9.523)	0.0710 (7.558)	0.0652 (8.552)	0.0669 (8.505)	0.0657 (7.396)
PERIODSQ	-0.000181 (-0.456)	-0.000949 (-0.918)	-0.000195 (-0.466)	-0.000739 (-1.539)	-0.000823 (-1.941)	-0.000751 (-1.509)
PERIODCU	-0.000006 (-0.849)	-0.000004 (-0.520)	-0.000006 (-0.801)	0.000001 (0.155)	0.000003 (0.337)	0.000001 (0.166)
R^2	0.999	0.999	0.999	0.999	0.999	0.999
Adj R^2	0.999	0.999	0.999	0.999	0.999	0.999
F	3906.94	4033.01	3453.50	3700.76	3850.33	3306.01
DW	1.235	1.282	1.237	1.261	1.277	1.261
Mean	7.563	7.563	7.563	7.563	7.563	7.563
S.D	0.480	0.408	0.480	0.480	0.480	0.480
RSS	0.007	0.007	0.007	0.007	0.007	0.007
Log-L	102.827	103.399	103.405	101.852	102.564	102.620

Table 6-3 Gross Domestic Product (in current values [LNGDP] and lagged [LGLNGDP]) as a predictor of the demand for health care, 1960 –1997

	LNGDP		LGLNGDP	
	Coefficient value and sign	**Statistical Significance**	**Coefficient value and sign**	**Statistical Significance**
Austria	All Positive, <1, but close to unity	Significant at 5% and 10% level	All positive; Significantly <1	Ambiguous: some not statistically significant; some significant at 10% level
Belgium	All Negative; Some >1 & some very significantly <1	Ambiguous: some not statistically significant; some significant at 1% level	Positive and negative; Very significantly <1	Not statistically significant
Denmark	All positive; very significantly <1	Not statistically significant	All positive; Significantly <1	Not statistically significant
Finland	Mostly positive, some negative; All very significantly <1	Not statistically significant	All positive; Significantly <1	Statistically significant at 5% or 1% level; ***some autocorrelation in AR(1) models limits explanatory power***
France	All positive; very significantly <1	Not statistically significant	All positive; very significantly <1	Not statistically significant
Germany	All positive; very significantly <1	Statistically significant at 1% or 10% level; ***some autocorrelation in the models limits explanatory power***	All negative; very significantly <1	Not statistically significant; ***some autocorrelation in models limits explanatory power***
Netherlands	All positive; significantly or very significantly <1	Ambiguous; some statistically significant at 1% level; others not stat. Significant; ***some autocorrelation in AR(1) models limits model explanatory power***	All positive; All <1, but some close to unity, others very significantly <1	Statistically significant at 1% or 5% level; ***some autocorrelation in AR(1) models limits model explanatory power***

Portugal	All positive; one close to unity; another significantly <1; another >1	Ambiguous: one is not significant; all others are significant at 1% or 5% level	Positive or negative; all very significantly <1 with the exception of one result, which is at unity, but negative	Not statistically significant
Spain	All positive; all >1	Statistically significant at 1%; ***persistence of autocorrelation in AR(1) models limits their explanatory power***	Positive and negative; All >1	Statistically significant at 1% or 5%; ***persistence of autocorrelation in AR(1) models limits their explanatory power***
Sweden	All negative; All very significantly <1	Not statistically significant	Positive or negative; all very significantly <1	Not statistically significant
Switzerland	Positive or negative; All very significantly <1	Not statistically significant	All positive; All very significantly <1	Ambiguous: some not statistically significant; some significant at 10% level
United Kingdom	Positive or negative; very significantly <1	Not statistically significant	Positive; very significantly <1	Ambiguous; ranging from not statistically significant to significant at 1% level
United States	Positive; very significantly <1	Not statistically significant; ***persistence of autocorrelation in AR(1) models limits explanatory power***	Negative; small coefficients close to zero	Not statistically significant; ***persistence of autocorrelation in AR(1) models limits explanatory power***

Source: Table 2.

Table 6-4 Determinants of Health Care Expenditures – Results of AR(1) method with Consumption as predictor of health spending

Austria							
	MODELS						
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6	EQ7
Constant	2.31 (0.84)	2.67 (0.80)	-5.60 (-0.94)	2.11 (0.74)	0.39 (0.10)	4.41 (1.29)	5.44 (1.56)
DEF95						-0.76E-05 (-1.97)	-0.95E-05 (-2.34)
DEFPCT	-0.023 (-3.22)	-0.025 (-3.44)	-0.028 (-3.67)	-0.019 (-2.49)			
DELTAGDP					-0.003 (-0.63)		
LNC95	0.61 (1.35)		0.53 (1.18)	0.65 (1.41)	1.23 (2.14)	0.63 (1.20)	
LGLNC		0.51 (1.00)					0.47 (0.86)
LGLNGDP			0.75 (1.42)				
PHEX				0.002 (0.34)	0.008 (0.86)	0.002 (0.28)	
PHRMPCT	0.002 (1.19)	0.002 (1.55)	0.002 (1.59)				0.001 (1.00)
PHYS	-0.11 (-0.52)	0.039 (0.16)	-0.017 (-0.071)	-0.082 (-0.37)			
SHARE	0.19 (4.67)	0.20 (4.75)	0.16 (3.65)	0.18 (4.19)			
AUS8397					-0.093 (-1.65)	-0.075 (-1.37)	-0.072 (-1.34)
PERIOD	0.006 (0.29)	0.008 (0.37)	-0.015 (-0.63)	0.008 (0.38)	0.040 (1.57)	0.023 (0.70)	0.068 (2.43)
PERIODSQ	0.15E-03 (0.16)	0.11E-03 (0.11)	0.11E-05 (0.001)	-0.24E-03 (-0.21)	-0.002 (-1.56)	0.003 (0.88)	-0.002 (-1.28)
PERIODCU	0.59E-05 (0.36)	0.13E-05 (0.083)	0.95E-05 (0.62)	0.93E-05 (0.54)	0.28E-04 (1.22)	-0.21E-03 (-1.35)	0.20E-04 (0.83)
PERIOD4						0.32E-05 (1.54)	
RHO	0.43 (2.82)	0.48 (3.23)	0.36 (2.32)	0.47 (3.12)	0.63 (04.83)	0.68 (5.54)	0.76 (6.85)
RSS	0.05	0.05	0.04	0.05	0.09	0.08	0.09
Std.Dev	0.04	0.04	0.04	0.04	0.06	0.05	0.06
R^2	0.994	0.994	0.994	0.993	0.988	0.990	0.989
Adj R^2	0.992	0.992	0.993	0.991	0.985	0.987	0.986
F	563.10	524.14	527.20	514.41	338.65	331.58	354.72
Log-L	68.05	66.77	69.66	66.44	55.95	58.60	56.77
DW	1.83	1.78	1.84	1.73	1.67	1.61	1.67

Table 6.4 (continued)						
Belgium						
	MODELS					
VARIABLES	**EQ1**	**EQ2**	**EQ3**	**EQ4**	**EQ5**	**EQ6**
Constant	3.91 (1.07)	1.27 (0.26)	8.23 (2.33)	5.80 (1.76)	6.29 (1.74)	6.20 (1.89)
DEF95				-0.24E-06 (-0.28)		-0.73E-06 (-0.81)
DEFPCT	-0.006 (-1.11)	-0.006 (-1.13)				
DELTAGDP			-0.004 (-1.60)		-0.004 (-1.52)	
LNC95	0.45 (0.97)	0.51 (1.09)			0.38 (0.81)	
LGLNC		0.29 (0.64)	0.14 (0.31)	0.16 (0.35)		0.18 (0.41)
PHEX	0.013 (2.09)	0.013 (2.11)		0.016 (3.14)	0.005 (0.95)	0.010 (1.79)
PHRMPCT			0.12E-03 (0.083)			
PHYS	0.023 (0.26)	0.020 (0.21)				
SHARE	0.14 (2.21)	0.13 (2.09)		0.17 (3.39)		0.13 (1.91)
PERIOD	0.028 (1.09)	0.018 (0.66)	0.038 (1.42)	-0.024 (-1.09)	0.062 (2.74)	0.041 (1.73)
PERIODSQ	-0.22E-03 (-0.18)	-0.31E-03 (-0.25)	0.005 (1.57)	0.006 (2.99)	-0.42E-03 (-0.35)	0.62E-05 (0.005)
PERIODCU	-0.23E-04 (-1.04)	-0.20E-04 (-0.84)	-0.22E-03 (-1.79)	-0.30E-03 (-3.50)	-0.15E-04 (-0.79)	-0.28E-04 (-1.27)
PERIOD4			0.26E-05 (1.63)	0.35E-05 (3.23)		
RHO	0.75 (6.68)	0.70 (5.85)	0.78 (7.46)	0.49 (3.35)	0.83 (8.90)	0.79 (7.59)
RSS	0.04	0.04	0.05	0.03	0.06	0.05
Std.Dev	0.04	0.04	0.43	0.03	0.04	0.04
R^2	0.996	0.997	0.995	0.997	0.995	0.996
Adj R^2	0.995	0.995	0.994	0.997	0.994	0.995
F	972.08	876.27	857.55	1361.63	920.02	955.13
Log-L	71.96	72.89	66.66	78.01	64.53	68.60
DW	1.92	1.93	1.51	1.86	1.66	1.85

Table 6.4 (continued)						
Denmark						
	MODELS					
VARIABLES	**EQ1**	**EQ2**	**EQ3**	**EQ4**	**EQ5**	**EQ6**
Constant	9.54 (1.82)	4.17 (1.04)	3.30 (0.81)	3.52 (0.93)	15.06 (4.01)	3.01 (0.77)
DEF95			-0.96E-05 (-2.03)	-0.58E-05 (-1.25)		-0.58E-05 (-1.22)
DEFPCT	-0.003 (-0.31)	-0.015 (-2.10)				
DELTAGDP					0.001 (0.25)	
LNC95	-0.61 (-0.89)				-1.01 (-1.74)	
LGLNC		0.31 (0.57)	0.40 (0.75)	0.71 (1.20)		0.79 (1.30)
PHEX		-0.033 (-2.90)	-0.033 (-2.93)		-0.030 (-2.76)	
PHRMPCT	0.005 (2.13)			0.004 (1.98)		0.005 (2.06)
PHYS	0.049 (0.29)	-0.059 (-0.38)		0.11 (0.66)		0.14 (0.80)
SHARE	0.22 (0.84)	0.24 (0.99)	0.26 (1.11)			
PERIOD	0.076 (2.15)	0.031 (0.82)	0.029 (0.79)	0.086 (3.84)	0.069 (2.87)	0.065 (1.50)
PERIODSQ	-0.003 (-1.21)	0.004 (1.10)	0.003 (0.93)	-0.003 (-1.69)	0.006 (2.05)	-0.40E-03 (-0.086)
PERIODCU	0.57E-04 (0.80)	-0.52E-04 (-0.76)	-0.38E-04 (-0.56)	0.32E-04 (1.07)	-0.13E-03 (-2.42)	-0.74E-04 (-0.39)
PERIOD4						0.15E-05 (0.57)
RHO	0.64 (4.88)	0.71 (6.05)	0.71 (6.00)	0.62 (4.74)	0.70 (5.81)	0.64 (4.99)
RSS	0.15	0.16	0.17	0.16	0.18	0.15
Std.Dev	0.07	0.08	0.08	0.07	0.08	0.07
R^2	0.977	0.976	0.974	0.976	0.972	0.977
Adj R^2	0.971	0.970	0.967	0.971	0.967	0.970
F	147.08	140.72	149.12	166.36	171.40	142.78
Log-L	47.61	46.83	44.87	46.79	43.99	47.09
DW	1.77	2.07	2.06	1.74	1.99	1.74

Table 6.4 (continued)						
Finland						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	5.76 (3.80)	5.56 (4.02)	2.26 (2.17)	6.03 (4.20)	7.35 (191.10)	7.40 (4.67)
DEF95				0.33E-05 (1.13)	0.61E-05 (2.41)	
DEFPCT						0.002 (0.76)
DELTAGDP	0.001 (0.65)	0.002 (0.90)	-0.003 (-1.60)		-0.003 (-1.54)	
LNC95			0.90 (4.81)			
LGLNC	0.30 (1.10)	0.30 (1.24)		0.23 (0.89)		0.13 (0.49)
PHEX		0.015 (3.84)	0.013 (4.36)			
PHRMPCT	0.004 (2.81)			0.004 (2.66)	0.003 (1.82)	0.004 (2.71)
PHYS				0.095 (0.73)		0.052 (0.44)
SHARE						-0.10 (-1.35)
PERIOD	0.084 (5.15)	0.11 (7.76)	0.092 (8.21)	0.13 (6.30)	0.14 (10.27)	0.11 (4.67)
PERIODSQ	-0.001 (-1.91)	-0.005 (-4.77)	-0.005 (-5.77)	-0.007 (-3.25)	-0.008 (-4.92)	-0.001 (-1.96)
PERIODCU	0.69E-05 (0.49)	0.50E-04 (3.39)	0.54E-04 (4.52)	0.24E-03 (2.72)	0.26E-03 (4.08)	0.19E-05 (0.13)
PERIOD4				-0.31E-05 (-2.64)	-0.34E-05 (-3.93)	
RHO	0.74 (6.49)	0.60 (4.47)	0.66 (5.23)	0.52 (3.58)	0.33 (2.07)	0.72 (6.14)
RSS	0.04	0.03	0.02	0.03	0.02	0.04
Std.Dev	0.04	0.03	0.03	0.03	0.03	0.04
R^2	0.994	0.996	0.997	0.996	0.997	0.995
Adj R^2	0.993	0.995	0.997	0.995	0.996	0.993
F	842.52	1226.43	1722.16	933.79	1300.07	662.68
Log-L	69.41	76.13	82.22	77.69	80.57	71.54
DW	1.54	1.65	1.52	1.59	1.80	1.52

Table 6.4 (continued)						
France						
	MODELS					
VARIABLES	**EQ1**	**EQ2**	**EQ3**	**EQ4**	**EQ5**	**EQ6**
Constant	4.999 (2.35)	9.19 (4.63)	7.82 (340.14)	7.07 (3.39)	5.05 (2.42)	8.35 (4.35)
DEF95	-0.60E-05 (-2.21)	-0.45E-05 (-1.66)	-0.47E-05 (-1.54)		-0.581E-05 (-2.20)	-0.40E-05 (-1.49)
DELTAGDP			0.001 (0.45)	-0.002 (-0.79)		
LNC95	0.49 (1.36)				0.48 (1.36)	
LGLNC		-0.25 (-0.73)		0.14 (0.40)		-0.092 (-0.28)
PHEX	-0.003 (-1.79)			-0.003 (-1.97)	-0.002 (-1.77)	
PHRMPCT		0.001 (2.46)	0.001 (2.32)			0.001 (2.31)
PHYS		0.079 (1.25)				
FR9597	0.003 (0.14)	-0.014 (-0.63)	-0.009 (-0.43)	-0.008 (-0.41)	-0.004 (-0.22)	-0.010 (-0.48)
PERIOD	0.065 (3.87)	0.10 (5.59)	0.089 (11.48)	0.077 (4.32)	0.063 (3.93)	0.094 (5.38)
PERIODSQ	-0.93E-03 (-1.18)	-0.002 (-2.10)	-0.001 (-1.69)	-0.84E-03 (-1.35)	-0.66E-03 (-1.21)	-0.002 (-1.77)
PERIODCU	0.15E-04 (0.47)	0.44E-05 (0.12)	-0.13E-05 (-0.034)	0.14E-05 (0.15)	0.23E-06 (0.025)	0.54E-06 (0.015)
PERIOD4	-0.23E-06 (-0.48)	0.29E-06 (0.55)	0.27E-06 (0.51)			0.25E-06 (0.49)
RHO	0.13 (0.80)	0.38 (2.41)	0.36 (2.28)	0.050 (0.30)	0.12 (0.75)	0.35 (2.24)
RSS	0.01	0.01	0.01	0.01	0.01	0.01
Std.Dev	0.01	0.01	0.02	0.02	0.01	0.02
R^2	0.999	0.999	0.999	0.999	0.999	0.999
Adj R^2	0.999	0.999	0.999	0.999	0.999	0.999
F	3887.05	3371.53	3669.90	4038.90	4580.20	3703.98
Log-L	103.81	104.04	102.77	101.44	103.70	102.94
DW	1.97	1.996	2.06	2.05	1.99	2.06

Table 6.4 (continued)						
Germany						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	2.74 (1.16)	3.33 (2.31)	5.93 (3.61)	2.04 (1.31)	8.01 (4.95)	6.96 (157.53)
DEF95						-0.69E-05 (-1.21)
DEFPCT	-0.003 (-1.18)	-0.003 (-1.28)	-0.002 (-0.76)	-0.004 (-1.26)		
DELTAGDP					-0.60E-03 (-0.30)	0.66E-03 (0.39)
LNC95	0.88 (2.48)	0.67 (2.06)		0.90 (2.60)		
LGLNC	-0.13 (-0.40)		0.04 (0.11)		-0.22 (-0.65)	
PHEX	0.006 (1.05)			0.006 (1.20)		
PHRMPCT		0.002 (2.18)	0.002 (2.31)		0.002 (2.63)	0.002 (2.54)
PHYS	-0.096 (-0.71)	-0.097 (-0.80)	-0.035 (-0.27)	-0.10 (-0.76)		
SHARE	0.050 (1.22)	0.04 (1.05)	0.071 (1.76)	0.047 (1.17)		
GR9197					-0.037 (-0.98)	-0.027 (-0.77)
PERIOD	0.035 (1.39)	0.044 (2.08)	0.056 (2.44)	0.030 (1.37)	0.029 (1.61)	0.022 (1.35)
PERIODSQ	-0.69E-03 (-0.55)	-0.24E-03 (-0.22)	-0.25E-03 (-0.22)	-0.75E-03 (-0.61)	0.007 (3.83)	0.007 (3.80)
PERIODCU	0.31E-05 (0.15)	-0.42E-05 (-0.23)	-0.85E-05 (-0.44)	0.54E-05 (0.27)	-0.38E-03 (-4.76)	-0.37E-03 (-4.77)
PERIOD4					0.52E-05 (4.99)	0.51E-05 (4.97)
RHO		0.83 (8.83)	0.80 (8.04)		0.69 (5.71)	0.72 (6.17)
RSS	0.05	0.05	0.05	0.05	0.02	0.03
Std.Dev	0.04	0.04	0.04	0.04	0.03	0.03
R^2	0.993	0.993	0.993	0.993	0.996	0.996
Adj R^2	0.991	0.992	0.991	0.991	0.995	0.995
F	444.50	522.69	489.18	494.62	973.21	893.77
Log-L	68.73	68.85	67.66	67.86	79.98	78.46
DW	1.52	1.39	1.46	1.53	1.75	1.62

Table 6.4 (continued)					
Netherlands					
	MODELS				
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5
Constant	-3.65 (-1.10)	3.97 (4.72)	3.98 (4.80)	5.17 (5.32)	6.58 (87.87)
DEF95			-0.10E-05 (-0.074)	0.39E-05 (0.25)	0.69E-05 (0.43)
DEFPCT	0.003 (0.54)				
DELTAGDP		-0.95E-04 (-0.04)			-0.001 (-0.62)
LNC95	0.042 (0.16)			0.29 (1.39)	
LGLNC		0.58 (3.15)	0.57 (3.20)		
LGLNGDP	1.18 (2.86)				
PHEX		-0.001 (-0.35)		0.004 (1.43)	
PHRMPCT	-0.11E-03 (-0.38)		0.10E-04 (0.045)		-0.12E-04 (-0.045)
PHYS	-0.048 (-0.38)		0.015 (0.16)		
SHARE	-0.16 (-1.29)				
PERIOD	0.060 (2.64)	0.037 (1.65)	0.040 (1.89)	0.089 (5.09)	0.10 (6.96)
PERIODSQ	-0.26E-03 (-0.21)	0.003 (1.18)	0.003 (1.17)	-0.003 (-2.86)	-0.002 (-2.54)
PERIODCU	-0.94E-05 (-0.45)	-0.20E-03 (-1.82)	-0.17E-03 (-1.91)	0.38E-04 (1.96)	0.25E-04 (1.42)
PERIOD4		0.28E-05 (2.06)	0.26E-05 (2.12)		
RHO	0.71 (5.91)	0.88 (10.82)	0.88 (11.14)	0.86 (10.13)	0.90 (12.31)
RSS	0.02	0.03	0.03	0.03	0.05
Std.Dev	0.03	0.03	0.03	0.03	0.04
R^2	0.997	0.995	0.996	0.995	0.993
Adj R^2	0.996	0.994	0.995	0.994	0.992
F	1111.05	887.20	872.50	1046.66	710.21
Log-L	83.84	73.97	76.71	73.54	66.60
DW	1.68	1.28	1.25	1.37	1.13

Table 6.4 (continued)						
Portugal						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	8.39 (3.22)	5.75 (1.66)	9.11 (5.58)	9.20 (7.74)	5.01 (5.61)	1.41 (0.73)
DEF95				0.28E-06 (0.66)	0.23E-06 (0.52)	0.62E-07 (0.14)
DEFPCT	0.003 (0.75)	0.002 (0.37)				
DELTAGDP			-0.002 (-0.39)		-0.001 (-0.33)	
LNC95		0.67 (1.93)				0.65 (1.94)
LGLNC	-0.071 (-0.63)		-0.10 (-0.78)	-0.089 (-0.88)		
LGLNGDP		-0.14 (-0.95)				
PHEX						0.64E-04 (0.018)
PHRMPCT	-0.001 (-1.56)	-0.001 (-1.53)	-0.001 (-1.72)	-0.001 (-1.62)	-0.001 (-1.97)	
PHYS	-0.63 (-2.58)	-0.29 (-0.98)		-0.66 (-3.27)		
SHARE	0.048 (0.32)	-0.071 (-0.48)				
PERIOD	0.32 (2.93)	0.21 (1.63)	0.28 (2.89)	0.29 (4.55)	0.97 (5.17)	0.57 (2.05)
PERIODSQ	-0.007 (-1.06)	-0.004 (-0.68)	-0.009 (-2.03)	-0.005 (-1.67)	-0.061 (-4.37)	-0.032 (-1.59)
PERIODCU	0.69E-04 (0.70)	0.47E-04 (0.52)	0.12E-03 (1.85)	0.38E-04 (0.81)	0.002 (3.97)	0.81E-03 (1.29)
PERIOD4					-0.17E-04 (-3.65)	-0.74E-05 (-1.06)
RHO	0.24 (1.27)	0.052 (0.27)	0.53 (3.28)	0.24 (1.30)	0.23 (1.26)	0.065 (0.34)
RSS	0.07	0.06	0.13	0.08	0.08	0.07
Std.Dev	0.002	0.06	0.08	0.06	0.06	0.06
R^2	0.99	0.990	0.980	0.988	0.989	0.989
Adj R^2	0.98	0.986	0.974	0.984	0.9856	0.985
F	204.382	207.65	171.71	244.11	248.61	249.15
Log-L	47.46	45.44	35.10	42.74	42.997	43.03
DW	1.84	1.97	1.78	1.84	1.81	1.93

Table 6.4 (continued)							
Spain							
VARIABLES	MODELS						
	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6	EQ7
Constant	1.81 (0.82)	-9.31 (-2.16)	3.33 (1.70)	6.39 (3.43)	4.84 (2.88)	5.68 (3.29)	5.42 (2.77)
DEF95							0.10E-06 (0.20)
DEFPCT	0.26E-03 (0.04)	-0.11E-03 (-0.016)	0.001 (0.24)				
DELTAGDP				0.003 (0.99)	0.002 (0.72)	0.003 (0.86)	
LNC95	0.56 (2.50)	0.36 (1.67)	0.66 (3.20)		0.53 (2.61)		0.46 (1.94)
LGLNC	0.29 (1.32)			0.34 (1.50)		0.43 (2.05)	
LGLNGDP		1.15 (3.16)					
PHEX	-0.011 (-2.03)		-0.010 (-1.87)	-0.013 (-2.06)	-0.009 (-1.65)	-0.008 (-1.49)	-0.011 (-1.91)
PHRMPCT		0.35^{E}-03 (0.20)					
PHYS	-0.17 (-1.60)	-0.12 (0.12)	-0.18 (-1.6)				
SHARE	0.90 (1.16)	0.056 (0.97)	0.084 (1.06)				
PERIOD	0.067 (1.81)	0.057 (1.92)	0.089 (2.52)	0.18 (4.00)	0.13 (4.50)	0.14 (4.57)	0.16 (3.50)
PERIODSQ	0.001 (0.70)	-0.90E-03 (-0.54)	0.67E-03 (0.30)	-0.007 (-1.75)	-0.002 (-1.20)	-0.003 (-1.44)	-0.005 (-1.27)
PERIODCU	-0.40E-04 (-1.07)	-0.49E-06 (-0.017)	-0.26E-04 (-0.72)	0.23E-03 (1.40)	0.24E-04 (0.84)	0.33E-04 (1.12)	0.16E-03 (0.96)
PERIOD4				-0.27E-05 (-1.23)			-0.19E-05 (-0.83)
RHO	0.59 (4.38)	0.34 (2.15)	0.62 (4.64)	0.74 (6.46)	0.80 (7.87)	0.79 (7.60)	0.75 (6.72)
RSS	0.04	0.04	0.05	0.05	0.07	0.08	0.05
Std.Dev	0.05	0.04	0.04	0.42	0.05	0.05	0.04
R^2	0.997	0.997	0.997	0.997	0.995	0.995	0.997
Adj R^2	0.996	0.996	0.996	0.996	0.994	0.994	0.996
F	1.09	1129.22	1045.29	1273.47	1034.95	1019.33	1297.35
Log-L	68.6	70.85	66.67	67.17	60.05	59.78	67.50
DW	1.73	1.73	1.72	1.80	1.59	1.66	1.76

Table 6.4 (continued)					
Sweden					
	MODELS				
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5
Constant	12.49 (6.90)	12.23 (3.89)	12.11 (6.80)	12.10 (7.09)	12.05 (6.94)
DEF95				0.12E-05 (1.22)	0.11E-05 (1.11)
DEFPCT	0.003 (2.04)	0.003 (1.69)	0.003 (1.82)		
LNC95	-0.63 (-2.24)	-0.64 (-2.16)	-0.59 (-2.08)	-0.59 (-2.19)	-0.58 (-2.11)
LGLNGDP		0.024 (0.097)			
PHEX			-0.30E-03 (-0.22)	-0.43E-03 (-0.34)	-0.37E-03 (-0.28)
PHRMPCT	-0.55E-03 (-0.82)	-0.54E-03 (-0.80)			
PHYS	-0.094 (-1.16)	-0.095 (-1.14)	-0.070 (-0.90)		
SHARE	0.19E-04 (0.00)	0.53E-03 (0.01)	0.006 (0.16)		
SWD9297				-0.003 (-0.12)	-0.004 (-0.15)
SWD9397				-0.023 (-0.87)	-0.026 (-0.97)
PERIOD	0.13 (14.05)	0.13 (9.72)	0.13 (13.25)	0.13 (13.53)	0.12 (8.42)
PERIODSQ	-0.003 (-3.36)	-0.003 (-3.23)	-0.003 (-3.57)	-0.003 (-5.89)	-0.002 (-1.62)
PERIODCU	0.20E-04 (1.09)	0.20E-04 (1.07)	0.24E-04 (1.34)	0.30E-04 (2.97)	-0.20E-04 (-0.40)
PERIOD4					0.69E-06 (1.04)
RHO	0.58 (4.25)	0.59 (4.30)	0.62 (4.63)	0.58 (4.20)	0.53 (3.68)
RSS	0.01	0.01	0.01	0.01	0.01
Std.Dev	0.02	0.02	0.02	0.22	0.02
R^2	0.997	0.997	0.997	0.997	0.997
Adj R^2	0.996	0.996	0.996	0.996	0.996
F	1222.91	1066.51	1180.53	1220.74	1112.87
Log-L	92.06	92.40	91.43	92.03	93.16
DW	1.72	1.72	1.65	1.72	1.70

Table 6.4 (continued)						
Switzerland						
	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	9.05 (5.24)	9.29 (5.41)	9.42 (5.72)	8.74 (4.54)	7.81 (4.40)	7.79 (4.27)
DEF95					-0.99E-05 (-0.68)	-0.97E-05 (-0.66)
DEFPCT	-0.007 (-1.05)	-0.007 (-1.08)	-0.003 (-0.49)			
DELTAGDP				-0.004 (-1.24)		
LNC95	-0.18 (-0.55)					
LGLNC		-0.23 (-0.71)	-0.24 (-0.80)	-0.35 (-0.96)	-0.17 (-0.51)	-0.15 (-0.44)
PHEX			0.004 (0.94)			
PHRMPCT	-0.67E-04 (-0.081)	-0.13E-04 (-0.016)		-0.46E-03 (-0.65)	-0.34E-03 (-0.47)	-0.18E-03 (-0.23)
PHYS	-0.24 (-1.48)	-0.22 (-1.40)	-0.26 (-1.67)			-0.15 (-0.88)
SHARE	-0.10 (-2.42)	-0.10 (-2.43)	-0.11 (-2.76)			
PERIOD	0.12 (9.35)	0.12 (9.17)	0.12 (9.56)	0.11 (8.38)	0.10 (7.35)	0.12 (6.14)
PERIODSQ	-0.001 (-1.90)	-0.001 (-1.87)	-0.002 (-2.20)	-0.003 (-4.70)	-0.002 (-3.23)	-0.004 (-2.150)
PERIODCU	0.22E-05 (0.14)	0.14E-05 (0.092)	0.81E-05 (0.49)	0.32E-04 (2.93)	0.26E-04 (1.83)	0.11E-03 (1.36)
PERIOD4						-0.12E-05 (-1.06)
RHO	0.25 (1.55)	0.27 (1.69)	0.20 (1.190)	0.56 (4.04)	0.61 (4.52)	0.47 (3.16)
RSS	0.03	0.03	0.03	0.04	0.04	0.03
Std.Dev	0.03	0.03	0.03	0.04	0.04	0.03
R^2	0.996	0.996	0.996	0.994	0.994	0.995
Adj R^2	0.995	0.995	0.995	0.993	0.993	0.994
F	898.69	894.02	938.02	872.53	801.25	745.98
Log-L	78.26	78.16	79.03	71.29	69.77	74.92
DW	1.87	1.84	1.88	1.81	1.77	1.72

Table 6.4 (continued)
United Kingdom

	MODELS					
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5	EQ6
Constant	4.02 (10.27)	4.70 (8.53)	3.51 (8.04)	5.43 (216.73)	3.78 (5.54)	3.57 (10.65)
DEF95	-0.99E-04 (-4.53)	-0.75E-04 (-2.92)	-0.10E-03 (-4.86)	-0.72E-04 (-2.92)		-0.10E-03 (-5.18)
DELTAGDP				-0.003 (-1.75)	0.82E-03 (0.38)	
LNC95		0.20 (1.38)				
LGLNC	0.38 (3.62)		0.49 (4.50)		0.45 (2.46)	0.51 (5.58)
PHEX		-0.70E-03 (-0.38)			0.003 (1.26)	
PHRMPCT	0.003 (1.17)		0.003 (1.32)	0.004 (1.39)		0.004 (1.67)
PHYS			0.13 (1.80)			
UK9197	-0.027 (-0.76)	0.022 (0.86)	-0.023 (-0.64)	-0.042 (-1.04)	0.053 (1.98)	-0.027 (-0.82)
PERIOD	0.045 (11.26)	0.044 (6.61)	0.040 (8.82)	0.051 (10.12)	0.025 (1.95)	0.027 (3.77)
PERIODSQ	-0.79E-03 (-3.09)	-0.44E-03 (-0.80)	-0.80E-03 (-3.44)	-0.86E-03 (-2.49)	0.002 (1.39)	0.001 (1.56)
PERIODCU	0.97E-05 (1.79)	0.31E-05 (0.39)	0.97E-05 (1.91)	0.13E-04 (1.84)	-0.12E-03 (-1.95)	-0.71E-04 (-2.42)
PERIOD4					0.17E-05 (2.03)	0.11E-05 (2.81)
RHO	0.18 (1.07)	0.36 (2.32)	0.070 (0.41)	0.45 (2.95)	0.36 (2.27)	-0.016 (-0.096)
RSS	0.008	0.01	0.007	0.01	0.01	0.006
Std.Dev	0.02	0.02	0.02	0.02	0.21	0.01
R^2	0.998	0.998	0.998	0.998	0.998	0.999
Adj R^2	0.998	0.997	0.998	0.997	0.997	0.998
F	2401.24	1710.59	2284.51	1754.65	1419.68	2611.45
Log-L	99.80	93.71	101.96	94.17	93.41	104.37
DW	2.02	1.85	2.02	1.96	1.96	2.01

Table 6.4 (continued)					
United States					
	MODELS				
VARIABLES	EQ1	EQ2	EQ3	EQ4	EQ5
Constant	7.70 (11.17)	6.88 (5.59)	4.99 (10.13)	4.96 (10.22)	5.02 (9.53)
DEF95				-0.47E-05 (-0.53)	-0.53E-05 (-0.57)
DEFPCT	-0.40E-03 (-0.19)	-0.001 (-0.80)			
DELTAGDP			0.17E-04 (0.021)		
LNC95		0.19 (1.51)	0.33 (3.13)	0.34 (3.25)	0.33 (2.96)
LGLNGDP		-0.033 (-0.28)			
LGLNC	-0.050 (-0.35)				
PHEX			0.010 (3.60)	0.009 (3.07)	0.008 (1.86)
PHRMPCT	0.002 (1.38)	0.78E-03 (0.61)			
PHYS	-0.071 (-1.61)	-0.061 (-1.40)			
SHARE	-0.076 (-3.10)	-0.071 (-2.96)			
PERIOD	0.077 (10.14)	0.069 (7.59)	0.062 (9.70)	0.062 (9.72)	0.064 (6.66)
PERIODSQ	-0.35E-03 (-0.95)	-0.25E-03 (-0.65)	-0.002 (-3.79)	-0.002 (-3.64)	-0.002 (-2.38)
PERIODCU	-0.40E-05 (-0.55)	-0.50E-05 (-0.70)	0.21E-04 (2.84)	0.21E-04 (2.85)	0.39E-04 (0.75)
PERIOD4					-0.26E-06 (-0.34)
RHO	0.80 (7.89)	0.79 (7.58)	0.84 (9.32)	0.84 (9.14)	0.83 (8.81)
RSS	0.006	0.006	0.009	0.008	0.007
Std.Dev	0.01	0.01	0.02	0.02	0.01
R^2	0.999	0.999	0.999	0.999	0.999
Adj R^2	0.999	0.999	0.999	0.999	0.999
F	4121.32	3611.77	4488.84	4820.89	4633.87
Log-L	103.79	104.21	98.86	100.15	102.84
DW	1.25	1.30	1.32	1.35	1.36

Table 6-5 Testing for Unit Roots ADF tests for all variables in first levels[1]

VARIABLES	COUNTRIES												
	France	UK	Sweden	Denmark	Spain	Portugal	Netherlands	Switzerland	USA	Finland	Germany	Austria	Belgium
LNGDP	-1.93	-4.1	-2.49	-3.46	-2.14	-16.15	-2.25	-2.39	-3.44	-2.26	-0.93	-1.1	-1.58
LNHEX	-1.53	-2.12	-2.99	-1.52	-2.75	-26.1	-1.55	-1.73	-2.36	-1.36	-1.16	-1.51	-0.3
LNC													
DEFICIT	-3.11	-3.02	-4.1	-3.58	-2.83	-4.22	-1.16	-1.23	-3.01	-2.43	-2.44	-3.71	-0.54
DEFPCT	-3.02	-3.54	-3.66	-2.92	2.57	-2.71	-1.09	-1.76	-2.46	-2.54	-2.68	-2.68	-0.56
DELTAGDP	-2.68	-3.91	-3.33	-4.32	-2.32	-3.96	-2.61	-2.9	-3.61	-3.28	-4.5	-2.65	-3.07
LNPUB95	-1.82	-1.91	-2.9	-1.59	-2.05	-14.7	-3.01	-1.54	-2.64	-1.79	-1.24	-1.59	-0.88
PHEX	-2.49	-2.08	-2.52	-2.44	-2.51	-6.18	-1.66	-3.81	-2.65	-2.35	-3.85	-2.25	-2.29
PHRMPCT	-2.29	-4.03	-1.61	-2.27	-2.47	-3.24	-2.9	-2.98	-1.54	-2.94	-4.67	-3.05	-2.96
PHYSICIAN	-2.00	-1.98	-1.29	-2.82	-2.06	-18.8	-2.82	-2.29	-1.92	-3.29	-2.48	0.9	-1.87

Notes: The McKinnon critical values are as follows: 1% ....: -4.2505; 5% ....: -3.5468; 10% ......: -3.2056

1 With 2 lagged differences.

Table 6-6 Testing for Unit Roots: ADF tests for all variables in first differences[1]

VARIABLES	COUNTRIES												
	France		Sweden	Denmar k	Spain	Portugal	Netherlan ds	Switzerl and	USA	Finland	Germany	Austria	Belgium
LNGDP95	-4.04	-3.91	-3.73	-4.43	-3.4	-4.45	-3.89	-4.03	-4.07	-3.91	-4.44	-5.28	-3.65
LNHCE95	-7.3	-5.63	-4.51	-5.68	-3.83	-3.84	-3.72	-6.16	-3.91	-4.25	-5.64	-4.72	-4.62
LNC95													
DEF95	-3.87	-3.91	-3.34	-3.99	-5.04	-4.35	-6.19	-5.46	-3.72	-4.15	-5.06	-4.34	-3.66
DEFPCT	-4.97	-5.06	-3.48	-3.09	-5.27	-4.78	-5.04	-3.73	-4.32	-4.05	-4.85	-5.16	-4.09
DELTAGDP	-6.25	-5.25	-4.94	-5.9	-4.76	-6.26	-5.28	-7.13	-5.05	-4.31	-5.81	-4.41	-5.36
LNPUB95	-5.83	-5.26	-4.66	-5.1	-4.94	-3.79	-4.25	-5.22	-3.4	-4.49	-5.14	-3.53	-5.21
PHEX	-1.15	-3.15	-6.88	-3.03	-3.21	-4.97	-2.15	-2.26	-0.48	-1.85	-3.2	-2.64	-2.47
PHRMPCT	-4.36	-4.88	-4.6	-4.77	-4.22	-4.28	-5.86	-5.02	-6.41	-6.58	-7.21	-4.54	-5.93
PHYS	-7.5	-7.49	-4.88	-5.67	-3.87	-4.18	-6.15	-9.12	-6.77	-8.44	-3.54	-10.19	-5.84

Notes: The McKinnon critical values are as follows: **1% ....: -4.2505; 5% ....: -3.5468; 10% ......: -3.2056**

[1] With 2 lagged differences

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Table 6-7 **Johansen tests with GDP as an independent variable**

Testing the existence of co-integrating relationships in each of the 13 sample countries

Procedure: Intercept (no trend) in Co-integrating Equation (CE) and test VAR
Lag interval pairs: {1:1}
Test assumption: Linear deterministic trend in the data
Variables: LNHEX, LNGDP, PHEX, DEFICIT, PHYSICIAN, PHRMPCT

Austria

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.713947	124.0225	94.15	103.18	None **
0.623377	80.21729	68.52	76.07	At most 1 **
0.471066	46.03943	47.21	54.46	At most 2
0.361362	23.74823	29.68	35.65	At most 3
0.201390	8.053622	15.41	20.04	At most 4
0.005207	0.182729	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Belgium

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.781252	132.6404	94.15	103.18	None **
0.622652	79.44622	68.52	76.07	At most 1 **
0.465624	45.33567	47.21	54.46	At most 2
0.336143	23.40275	29.68	35.65	At most 3
0.164502	9.063656	15.41	20.04	At most 4
0.076177	2.773219	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Denmark

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.681462	103.2697	94.15	103.18	None **
0.524876	63.22925	68.52	76.07	At most 1
0.460105	37.18295	47.21	54.46	At most 2
0.274489	15.60962	29.68	35.65	At most 3
0.111075	4.378846	15.41	20.04	At most 4
0.007340	0.257847	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Finland

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.659496	118.5269	94.15	103.18	None **
0.651520	80.82045	68.52	76.07	At most 1 **
0.446111	43.92433	47.21	54.46	At most 2
0.344327	23.24663	29.68	35.65	At most 3
0.174788	8.473389	15.41	20.04	At most 4
0.048754	1.749374	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

France				
Sample: 1962 – 1997 Included observations: 35 Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.764880	136.4654	94.15	103.18	None **
0.630078	85.79734	68.52	76.07	At most 1 **
0.465824	50.99115	47.21	54.46	At most 2 *
0.355802	29.04508	29.68	35.65	At most 3
0.237349	13.65385	15.41	20.04	At most 4
0.112330	4.170413	3.76	6.65	At most 5 *
*(**) denotes rejection of the hypothesis at 5%(1%) significance level L.R. test indicates 3 cointegrating equation(s) at 5% significance level				

Germany				
Sample: 1962 – 1997 Included observations: 35 Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.799412	153.3615	94.15	103.18	None **
0.707864	97.13398	68.52	76.07	At most 1 **
0.466448	54.06521	47.21	54.46	At most 2 *
0.397564	32.07825	29.68	35.65	At most 3 *
0.310012	14.34114	15.41	20.04	At most 4
0.037927	1.353291	3.76	6.65	At most 5
*(**) denotes rejection of the hypothesis at 5%(1%) significance level L.R. test indicates 4 cointegrating equation(s) at 5% significance level				

Netherlands				
Sample: 1962 – 1997				
Included observations: 35				
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT				
Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.751899	135.8556	94.15	103.18	None **
0.655035	87.06842	68.52	76.07	At most 1 **
0.472180	49.81752	47.21	54.46	At most 2 *
0.346089	27.45251	29.68	35.65	At most 3
0.250770	12.58506	15.41	20.04	At most 4
0.068411	2.480209	3.76	6.65	At most 5
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 3 cointegrating equation(s) at 5% significance level				

Portugal				
Sample: 1962 – 1997				
Included observations: 25				
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT				
Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.871502	156.7198	94.15	103.18	None **
0.748923	105.4237	68.52	76.07	At most 1 **
0.704691	70.87386	47.21	54.46	At most 2 **
0.559890	40.38057	29.68	35.65	At most 3 **
0.345111	19.86232	15.41	20.04	At most 4 *
0.310096	9.280077	3.76	6.65	At most 5 **
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 6 cointegrating equation(s) at 5% significance level				

Spain

Sample: 1962 – 1997
Included observations: 34
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.833460	165.6972	94.15	103.18	None **
0.759288	104.7516	68.52	76.07	At most 1 **
0.573362	56.33041	47.21	54.46	At most 2 **
0.384653	27.36854	29.68	35.65	At most 3
0.222717	10.85920	15.41	20.04	At most 4
0.065214	2.292869	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

Sweden

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.804888	158.0125	94.15	103.18	None **
0.674735	100.8161	68.52	76.07	At most 1 **
0.591903	61.50704	47.21	54.46	At most 2 **
0.406468	30.13827	29.68	35.65	At most 3 *
0.210103	11.88003	15.41	20.04	At most 4
0.098393	3.625170	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 4 cointegrating equation(s) at 5% significance level

Switzerland

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.661694	121.4553	94.15	103.18	None **
0.611691	83.52210	68.52	76.07	At most 1 **
0.494886	50.41370	47.21	54.46	At most 2 *
0.410729	26.50972	29.68	35.65	At most 3
0.195774	7.999328	15.41	20.04	At most 4
0.010620	0.373699	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

United Kingdom

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.728920	125.2886	94.15	103.18	None **
0.548093	79.60161	68.52	76.07	At most 1 **
0.519201	51.80182	47.21	54.46	At most 2 *
0.415700	26.17111	29.68	35.65	At most 3
0.182648	7.364205	15.41	20.04	At most 4
0.008682	0.305202	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

USA				
Sample: 1962 – 1997				
Included observations: 34				
Series: LNHEX LNGDP PHEX DEFICIT PHYSICIAN PHRMPCT				
Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.853908	147.6749	94.15	103.18	None **
0.543814	82.27528	68.52	76.07	At most 1 **
0.462959	55.59026	47.21	54.46	At most 2 **
0.414744	34.45310	29.68	35.65	At most 3 *
0.296335	16.23909	15.41	20.04	At most 4 *
0.118533	4.289701	3.76	6.65	At most 5 *
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 6 cointegrating equation(s) at 5% significance level				

Table 6-8 Johansen tests with Consumption as an independent variable

Testing the existence of co-integrating relationships in each of the 13 sample countries

Procedure: Intercept (no trend) in Co-integrating Equation (CE) and test VAR
Lag interval pairs: {1:1}
Test assumption: Linear deterministic trend in the data
Variables: LNHEX, LNC, PHEX, DEFICIT, PHYSICIAN, PHRMPCT

Austria

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.774764	129.9611	94.15	103.18	None **
0.609614	77.78990	68.52	76.07	At most 1 **
0.501079	44.86822	47.21	54.46	At most 2
0.346102	20.53249	29.68	35.65	At most 3
0.148794	5.664340	15.41	20.04	At most 4
0.000737	0.025800	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Belgium

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.773655	139.0428	94.15	103.18	None **
0.717013	87.04359	68.52	76.07	At most 1 **
0.431146	42.86119	47.21	54.46	At most 2
0.328899	23.11659	29.68	35.65	At most 3
0.193387	9.157346	15.41	20.04	At most 4
0.045652	1.635451	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Denmark

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.637061	96.30650	94.15	103.18	None *
0.481673	60.83325	68.52	76.07	At most 1
0.383583	37.83306	47.21	54.46	At most 2
0.276646	20.89897	29.68	35.65	At most 3
0.198604	9.564012	15.41	20.04	At most 4
0.050536	1.815002	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation at 5% significance level

Finland

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.689842	119.9714	94.15	103.18	None **
0.557720	78.99783	68.52	76.07	At most 1 **
0.480030	50.44437	47.21	54.46	At most 2 *
0.404180	27.55490	29.68	35.65	At most 3
0.178327	9.431342	15.41	20.04	At most 4
0.070450	2.556901	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

France

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.811757	174.1987	94.15	103.18	None **
0.753161	115.7480	68.52	76.07	At most 1 **
0.643180	66.78233	47.21	54.46	At most 2 **
0.371401	30.71404	29.68	35.65	At most 3 *
0.229752	14.46486	15.41	20.04	At most 4
0.141217	5.328368	3.76	6.65	At most 5 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 4 cointegrating equation(s) at 5% significance level

Germany

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC DEFICIT PHYSICIAN PHEX PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.768099	136.9126	94.15	103.18	None **
0.647222	85.76204	68.52	76.07	At most 1 **
0.457879	49.29499	47.21	54.46	At most 2 *
0.328279	27.86566	29.68	35.65	At most 3
0.308569	13.93874	15.41	20.04	At most 4
0.028833	1.024005	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

Netherlands

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.821646	137.2075	94.15	103.18	None **
0.636828	76.86799	68.52	76.07	At most 1 **
0.408503	41.41722	47.21	54.46	At most 2
0.247267	23.03877	29.68	35.65	At most 3
0.197931	13.09723	15.41	20.04	At most 4
0.142424	5.377610	3.76	6.65	At most 5 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Portugal

Sample: 1962 – 1997
Included observations: 25
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.925827	162.2396	94.15	103.18	None **
0.831229	97.20569	68.52	76.07	At most 1 **
0.582652	52.72539	47.21	54.46	At most 2 *
0.513799	30.87953	29.68	35.65	At most 3 *
0.352187	12.85120	15.41	20.04	At most 4
0.076786	1.997367	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 4 cointegrating equation(s) at 5% significance level

Spain

Sample: 1962 – 1997
Included observations: 34
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.919697	200.3809	94.15	103.18	None **
0.804665	114.6346	68.52	76.07	At most 1 **
0.518902	59.11130	47.21	54.46	At most 2 **
0.451160	34.23407	29.68	35.65	At most 3 *
0.297492	13.83585	15.41	20.04	At most 4
0.052414	1.830490	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 4 cointegrating equation(s) at 5% significance level

Sweden

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.793185	159.5865	94.15	103.18	None **
0.679000	104.4288	68.52	76.07	At most 1 **
0.611982	64.65781	47.21	54.46	At most 2 **
0.463916	31.52319	29.68	35.65	At most 3 *
0.141345	9.701944	15.41	20.04	At most 4
0.117335	4.368344	3.76	6.65	At most 5 *

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 4 cointegrating equation(s) at 5% significance level

Switzerland

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.696456	121.9177	94.15	103.18	None **
0.629284	80.18972	68.52	76.07	At most 1 **
0.433349	45.45854	47.21	54.46	At most 2
0.401073	25.57814	29.68	35.65	At most 3
0.192678	7.636628	15.41	20.04	At most 4
0.004148	0.145471	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

United Kingdom

Sample: 1962 – 1997
Included observations: 35
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.731400	122.0363	94.15	103.18	None **
0.529333	76.02766	68.52	76.07	At most 1 *
0.508462	49.65153	47.21	54.46	At most 2 *
0.383665	24.79394	29.68	35.65	At most 3
0.197763	7.855163	15.41	20.04	At most 4
0.004073	0.142850	3.76	6.65	At most 5

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 3 cointegrating equation(s) at 5% significance level

USA				
Sample: 1962 – 1997				
Included observations: 34				
Series: LNHEX LNC PHEX DEFICIT PHYSICIAN PHRMPCT				
Lags interval: 1 to 1				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.842015	155.9719	94.15	103.18	None **
0.713104	93.23316	68.52	76.07	At most 1 **
0.462586	50.77956	47.21	54.46	At most 2 *
0.341874	29.66604	29.68	35.65	At most 3
0.266974	15.44183	15.41	20.04	At most 4 *
0.133763	4.882308	3.76	6.65	At most 5 *
*(**) denotes rejection of the hypothesis at 5%(1%) significance level				
L.R. test indicates 3 cointegrating equation(s) at 5% significance level				

Table 6-9 Co-integrating regressions for each country (with GDP included as regressor in levels)[1,2,3]

Austria				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-14.87825	3.756732	-3.960423	0.0004
LNGDP	1.577587	0.173074	9.115113	0.0000
DEFICIT	-1.54E-05	5.07E-06	-3.031115	0.0048
PHYSICIAN	-0.016639	0.200771	-0.082877	0.9345
PHEX	-0.002613	0.005088	-0.513538	0.6111
R-squared	0.986659	Mean dependent var		18.37889
Adjusted R-squared	0.984992	S.D. dependent var		0.528217
S.E. of regression	0.064711	Akaike info criterion		-2.512689
Sum squared resid	0.134000	Schwarz criterion		-2.294998
Log likelihood	51.48475	F-statistic		591.6728
Durbin-Watson stat	0.662044	Prob(F-statistic)		0.000000

Belgium				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.50099	2.117583	-7.792372	0.0000
LNGDP	-0.307964	0.632374	-0.486997	0.6299
LNGDP(-1)	1.904327	0.655663	2.904429	0.0070
DEFICIT	-2.40E-06	9.95E-07	-2.415859	0.0222
DEFPCT	-0.000476	0.000375	-1.269120	0.2145
PHYSICIAN	0.175155	0.107921	1.622999	0.1154
PHRMPCT	-0.005941	0.002652	-2.240389	0.0329
PHEX	-0.002654	0.002870	-0.924689	0.3628
R-squared	0.994175	Mean dependent var		19.58524
Adjusted R-squared	0.992768	S.D. dependent var		0.611562
S.E. of regression	0.052006	Akaike info criterion		-2.886091
Sum squared resid	0.078435	Schwarz criterion		-2.537784
Log likelihood	61.39268	F-statistic		707.0262
Durbin-Watson stat	0.988650	Prob(F-statistic)		0.000000

Denmark				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-31.23683	7.375623	-4.235145	0.0002
LNGDP	0.476947	0.824097	0.578751	0.5671
LNGDP(-1)	1.956821	0.658255	2.972738	0.0058
PHRMPCT	-0.005035	0.004268	-1.179831	0.2473
PHEX	0.001695	0.005874	0.288622	0.7749
PHYSICIAN	-0.322367	0.237500	-1.357337	0.1848
DEFICIT(-1)	-1.68E-05	4.75E-06	-3.535160	0.0013
R-squared	0.959993	Mean dependent var		17.70557
Adjusted R-squared	0.951991	S.D. dependent var		0.495517
S.E. of regression	0.108572	Akaike info criterion		-1.434145
Sum squared resid	0.353638	Schwarz criterion		-1.129376
Log likelihood	33.53168	F-statistic		119.9775
Durbin-Watson stat	0.954563	Prob(F-statistic)		0.000000

Finland				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-17.32966	3.712176	-4.668330	0.0001
LNGDP	-0.186490	0.412392	-0.452216	0.6544
LNGDP(-1)	1.934841	0.409570	4.724078	0.0001
PHRMPCT	0.002873	0.003352	0.857288	0.3981
PHEX	-0.002245	0.002273	-0.987467	0.3313
PHYSICIAN	-0.016598	0.157725	-0.105233	0.9169
DEFICIT(-1)	-1.09E-05	5.17E-06	-2.102029	0.0441
R-squared	0.988565	Mean dependent var		17.00460
Adjusted R-squared	0.986278	S.D. dependent var		0.538590
S.E. of regression	0.063092	Akaike info criterion		-2.519791
Sum squared resid	0.119418	Schwarz criterion		-2.215023
Log likelihood	53.61614	F-statistic		432.2403
Durbin-Watson stat	0.813694	Prob(F-statistic)		0.000000

France

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-14.85303	0.717568	-20.69912	0.0000
LNGDP	1.544411	0.033535	46.05307	0.0000
DEFICIT	-1.27E-05	2.81E-06	-4.517662	0.0001
PHRMPCT	0.000269	0.000740	0.363308	0.7188
PHYSICIAN	-0.089606	0.048375	-1.852319	0.0735
PHEX	0.003189	0.000899	3.545788	0.0013

R-squared	0.998895	Mean dependent var	19.74269
Adjusted R-squared	0.998717	S.D. dependent var	0.555977
S.E. of regression	0.019917	Akaike info criterion	-4.847098
Sum squared resid	0.012297	Schwarz criterion	-4.585868
Log likelihood	95.67131	F-statistic	5604.293
Durbin-Watson stat	1.247768	Prob(F-statistic)	0.000000

Germany

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18.95341	2.770290	-6.841669	0.0000
LNGDP	3.436742	4.518849	0.760535	0.4529
LNGDP(-1)	-1.665951	4.420968	-0.376830	0.7090
DEFICIT	-3.36E-05	1.19E-05	-2.835379	0.0081
PHYSICIAN	-0.555559	0.119761	-4.638910	0.0001
DELTAGDP	-0.020548	0.045207	-0.454539	0.6527
PHEX	0.015563	0.002959	5.259085	0.0000

R-squared	0.994051	Mean dependent var	19.15523
Adjusted R-squared	0.992861	S.D. dependent var	0.495454
S.E. of regression	0.041863	Akaike info criterion	-3.340177
Sum squared resid	0.052575	Schwarz criterion	-3.035409
Log likelihood	68.79327	F-statistic	835.4252
Durbin-Watson stat	0.943019	Prob(F-statistic)	0.000000

The Netherlands				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-18.26642	1.666910	-10.95825	0.0000
LNGDP	1.808672	0.086180	20.98726	0.0000
DEFICIT	-2.73E-05	1.88E-05	-1.456538	0.1553
PHRMPCT	0.000329	0.000642	0.512017	0.6123
PHYSICIAN	-0.581748	0.079446	-7.322581	0.0000
PHEX	0.009932	0.001898	5.233802	0.0000
R-squared	0.995121	Mean dependent var		17.18018
Adjusted R-squared	0.994334	S.D. dependent var		0.578435
S.E. of regression	0.043540	Akaike info criterion		-3.282858
Sum squared resid	0.058769	Schwarz criterion		-3.021628
Log likelihood	66.73288	F-statistic		1264.537
Durbin-Watson stat	0.892112	Prob(F-statistic)		0.000000

Spain				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-37.96181	1.790514	-21.20162	0.0000
LNGDP	2.429838	0.074809	32.48048	0.0000
DEFPCT	-5.15E-05	3.57E-05	-1.442420	0.1599
PHRMPCT	-0.003754	0.002529	-1.484028	0.1486
PHYSICIAN	0.076255	0.064937	1.174297	0.2498
PHEX	-0.005017	0.002071	-2.421996	0.0219
R-squared	0.994855	Mean dependent var		21.56034
Adjusted R-squared	0.993967	S.D. dependent var		0.704549
S.E. of regression	0.054722	Akaike info criterion		-2.818307
Sum squared resid	0.086840	Schwarz criterion		-2.551676
Log likelihood	55.32037	F-statistic		1121.427
Durbin-Watson stat	1.027906	Prob(F-statistic)		0.000000

Sweden

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-22.09395	4.725752	-4.675224	0.0001
LNGDP	1.931145	0.236627	8.161137	0.0000
DEFICIT	-7.15E-06	1.82E-06	-3.918949	0.0005
PHRMPCT	-0.005051	0.002616	-1.931160	0.0627
PHYSICIAN	0.461611	0.187732	2.458883	0.0197
PHEX	-0.013679	0.003404	-4.018096	0.0003

R-squared	0.979101	Mean dependent var	18.38300
Adjusted R-squared	0.975730	S.D. dependent var	0.432621
S.E. of regression	0.067398	Akaike info criterion	-2.409019
Sum squared resid	0.140816	Schwarz criterion	-2.147789
Log likelihood	50.56686	F-statistic	290.4591
Durbin-Watson stat	1.201785	Prob(F-statistic)	0.000000

Switzerland

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-13.94538	4.182930	-3.333878	0.0022
LNGDP	1.580320	0.214900	7.353745	0.0000
DEFICIT	1.04E-05	1.63E-05	0.641798	0.5257
PHRMPCT	0.001083	0.001842	0.588066	0.5607
PHYSICIAN	-0.760673	0.212308	-3.582878	0.0011
PHEX	0.016739	0.003368	4.969208	0.0000

R-squared	0.987489	Mean dependent var	16.71005
Adjusted R-squared	0.985471	S.D. dependent var	0.553388
S.E. of regression	0.066703	Akaike info criterion	-2.429749
Sum squared resid	0.137927	Schwarz criterion	-2.168519
Log likelihood	50.95036	F-statistic	489.3702
Durbin-Watson stat	0.821775	Prob(F-statistic)	0.000000

UK				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-8.605850	1.873367	-4.593788	0.0001
LNGDP	1.258922	0.098007	12.84517	0.0000
DEFICIT	-0.000146	3.27E-05	-4.464138	0.0001
PHRMPCT	0.006085	0.003138	1.939057	0.0616
PHYSICIAN	0.422126	0.087674	4.814727	0.0000
PHEX	-0.000306	0.000481	-0.635654	0.5297
R-squared	0.994460	Mean dependent var		17.09876
Adjusted R-squared	0.993567	S.D. dependent var		0.411809
S.E. of regression	0.033030	Akaike info criterion		-3.835397
Sum squared resid	0.033821	Schwarz criterion		-3.574167
Log likelihood	76.95485	F-statistic		1112.989
Durbin-Watson stat	1.210651	Prob(F-statistic)		0.000000

USA				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1996				
Included observations: 36 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-19.04218	2.321317	-8.203182	0.0000
LNGDP	1.748624	0.115460	15.14478	0.0000
DEFICIT	-0.000114	2.35E-05	-4.844742	0.0000
PHRMPCT	-0.008820	0.003516	-2.508495	0.0180
DEFPCT	-1.95E-06	2.37E-06	-0.825268	0.4160
PHYSICIAN	-0.061516	0.177867	-0.345855	0.7319
PHEX	0.005009	0.001473	3.401409	0.0020
R-squared	0.997028	Mean dependent var		19.85160
Adjusted R-squared	0.996413	S.D. dependent var		0.589250
S.E. of regression	0.035289	Akaike info criterion		-3.677800
Sum squared resid	0.036115	Schwarz criterion		-3.369894
Log likelihood	73.20040	F-statistic		1621.562
Durbin-Watson stat	1.008715	Prob(F-statistic)		0.000000

Notes: [1] Period under investigation is 1960 – 1997.

[2] Dependent variable is always the Log of health care expenditures in constant 1995 national currency units.

[3] Last right hand column in each country table indicates levels of significance for each variable.

Table 6-10 Co-integrating regressions for each country (with Consumption included as regressor in levels)

Austria				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1962 1997				
Included observations: 36 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNC	3.617917	1.460907	2.476487	0.0191
LNC(-1)	-0.918852	1.474163	-0.623304	0.5378
DEFICIT	2.81E-05	9.62E-06	2.921905	0.0066
DEFPCT	-7.82E-05	9.30E-05	-0.841515	0.4067
PHYSICIAN	-0.264901	0.114349	-2.316596	0.0275
PHRMPCT	-0.001317	0.005739	-0.229445	0.8201
R-squared	0.918080	Mean dependent var		18.40643
Adjusted R-squared	0.904426	S.D. dependent var		0.508056
S.E. of regression	0.157066	Akaike info criterion		-0.713296
Sum squared resid	0.740087	Schwarz criterion		-0.449376
Log likelihood	18.83932	Durbin-Watson stat		0.570092

Belgium				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.158699	1.065562	-0.148935	0.8826
LNC	0.502179	0.596084	0.842463	0.4064
LNC(-1)	1.943381	0.642822	3.023200	0.0052
DEFICIT	-1.04E-06	8.75E-07	-1.184569	0.2458
DEFPCT	0.000196	0.000305	0.643008	0.5253
PHYSICIAN	-0.092547	0.095187	-0.972260	0.3390
PHRMPCT	-0.005463	0.002445	-2.233884	0.0334
PHEX	-0.001014	0.002514	-0.403286	0.6897
R-squared	0.995046	Mean dependent var		19.58524
Adjusted R-squared	0.993851	S.D. dependent var		0.611562
S.E. of regression	0.047957	Akaike info criterion		-3.048221
Sum squared resid	0.066696	Schwarz criterion		-2.699914
Log likelihood	64.39209	F-statistic		832.2016
Durbin-Watson stat	1.130450	Prob(F-statistic)		0.000000

Denmark

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.263786	3.060700	-1.393075	0.1738
LNC	0.419079	0.911940	0.459547	0.6492
LNC(-1)	2.893385	0.905900	3.193935	0.0033
PHRMPCT	-0.004885	0.004609	-1.059855	0.2977
PHEX	-0.007637	0.006424	-1.188865	0.2438
PHYSICIAN	0.214029	0.255993	0.836076	0.4097
DEFICIT(-1)	-1.31E-05	5.28E-06	-2.487222	0.0187

R-squared	0.953775	Mean dependent var	17.70557
Adjusted R-squared	0.944530	S.D. dependent var	0.495517
S.E. of regression	0.116705	Akaike info criterion	-1.289685
Sum squared resid	0.408598	Schwarz criterion	-0.984917
Log likelihood	30.85918	F-statistic	103.1668
Durbin-Watson stat	0.823856	Prob(F-statistic)	0.000000

Finland

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.745804	1.491230	2.511889	0.0174
LNC	2.178478	0.277807	7.841702	0.0000
PHRMPCT	0.003469	0.003838	0.903686	0.3731
PHYSICIAN	0.009334	0.188576	0.049495	0.9608
DEFPCT	6.64E-05	0.000151	0.439006	0.6637
PHEX	-0.001061	0.002642	-0.401602	0.6907

R-squared	0.983494	Mean dependent var	17.00460
Adjusted R-squared	0.980831	S.D. dependent var	0.538590
S.E. of regression	0.074568	Akaike info criterion	-2.206807
Sum squared resid	0.172374	Schwarz criterion	-1.945577
Log likelihood	46.82594	F-statistic	369.4118
Durbin-Watson stat	0.522885	Prob(F-statistic)	0.000000

France

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.007667	0.271268	22.14664	0.0000
LNC	2.144060	0.047468	45.16871	0.0000
DEFICIT	-1.21E-05	2.86E-06	-4.233317	0.0002
PHRMPCT	0.000506	0.000756	0.669768	0.5080
PHYSICIAN	0.086707	0.047646	1.819808	0.0785
PHEX	-0.002221	0.000912	-2.434840	0.0208

R-squared	0.998852	Mean dependent var	19.74269
Adjusted R-squared	0.998667	S.D. dependent var	0.555977
S.E. of regression	0.020301	Akaike info criterion	-4.808888
Sum squared resid	0.012776	Schwarz criterion	-4.547658
Log likelihood	94.96442	F-statistic	5393.960
Durbin-Watson stat	1.378606	Prob(F-statistic)	0.000000

Germany

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.071387	0.739397	12.26863	0.0000
LNC	3.118159	1.135023	2.747222	0.0101
LNC(-1)	-1.156799	1.135130	-1.019089	0.3163
DEFICIT	-2.34E-05	1.76E-05	-1.330375	0.1934
PHYSICIAN	-0.425698	0.116389	-3.657541	0.0010
DELTAGDP	-0.007610	0.007650	-0.994867	0.3278
PHEX	0.012096	0.003780	3.200002	0.0032

R-squared	0.988556	Mean dependent var	19.15523
Adjusted R-squared	0.986267	S.D. dependent var	0.495454
S.E. of regression	0.058061	Akaike info criterion	-2.685971
Sum squared resid	0.101134	Schwarz criterion	-2.381202
Log likelihood	56.69045	F-statistic	431.8989
Durbin-Watson stat	0.678004	Prob(F-statistic)	0.000000

The Netherlands				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.560563	0.627411	10.45656	0.0000
LNC	2.098353	0.128896	16.27939	0.0000
DEFICIT	-1.67E-05	2.35E-05	-0.709173	0.4835
PHRMPCT	8.11E-05	0.000811	0.100049	0.9209
PHYSICIAN	-0.305672	0.102608	-2.979041	0.0056
PHEX	0.005446	0.002576	2.114365	0.0426
R-squared	0.992229	Mean dependent var		17.18018
Adjusted R-squared	0.990976	S.D. dependent var		0.578435
S.E. of regression	0.054949	Akaike info criterion		-2.817435
Sum squared resid	0.093601	Schwarz criterion		-2.556206
Log likelihood	58.12256	F-statistic		791.6570
Durbin-Watson stat	1.042270	Prob(F-statistic)		0.000000

Spain				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-5.320705	1.711743	-3.108354	0.0042
LNC	2.934808	0.196446	14.93955	0.0000
DEFPCT	0.000139	7.04E-05	1.979488	0.0573
PHRMPCT	-0.005702	0.005249	-1.086435	0.2862
PHYSICIAN	0.325840	0.131655	2.474947	0.0194
PHEX	-0.009620	0.004317	-2.228196	0.0338
R-squared	0.977884	Mean dependent var		21.56034
Adjusted R-squared	0.974071	S.D. dependent var		0.704549
S.E. of regression	0.113451	Akaike info criterion		-1.360093
Sum squared resid	0.373260	Schwarz criterion		-1.093462
Log likelihood	29.80163	F-statistic		256.4510
Durbin-Watson stat	1.400154	Prob(F-statistic)		0.000000

Sweden

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1961 1997
Included observations: 37 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.039790	2.762337	-0.014405	0.9886
LNC	2.726201	0.455862	5.980320	0.0000
DEFICIT	-5.74E-06	2.18E-06	-2.630854	0.0131
PHRMPCT	-0.004654	0.003163	-1.471280	0.1513
PHYSICIAN	0.548017	0.234888	2.333093	0.0263
PHEX	-0.017201	0.003960	-4.344063	0.0001

R-squared	0.969447	Mean dependent var	18.38300
Adjusted R-squared	0.964519	S.D. dependent var	0.432621
S.E. of regression	0.081491	Akaike info criterion	-2.029267
Sum squared resid	0.205862	Schwarz criterion	-1.768037
Log likelihood	43.54143	F-statistic	196.7239
Durbin-Watson stat	1.091319	Prob(F-statistic)	0.000000

Switzerland

Dependent Variable: LNHEX
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.475274	2.161601	2.995591	0.0057
LNC	1.837511	0.385922	4.761355	0.0001
DEFPCT	-2.04E-05	1.48E-05	-1.382677	0.1777
DEFPCT(-1)	-3.77E-05	1.48E-05	-2.552886	0.0164
DEFICIT	-8.74E-06	2.10E-05	-0.415880	0.6807
PHRMPCT	0.001940	0.002082	0.931620	0.3595
PHYSICIAN	-0.822546	0.275923	-2.981066	0.0059
PHEX	0.018417	0.004405	4.180576	0.0003

R-squared	0.983423	Mean dependent var	16.74365
Adjusted R-squared	0.979278	S.D. dependent var	0.521563
S.E. of regression	0.075079	Akaike info criterion	-2.147414
Sum squared resid	0.157833	Schwarz criterion	-1.795521
Log likelihood	46.65345	F-statistic	237.2921
Durbin-Watson stat	0.838133	Prob(F-statistic)	0.000000

UK				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1997				
Included observations: 37 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.76617	0.613660	17.54421	0.0000
LNC	1.357965	0.176423	7.697208	0.0000
DEFICIT	-0.000152	4.88E-05	-3.116084	0.0039
PHRMPCT	0.007497	0.004626	1.620666	0.1152
PHYSICIAN	0.776370	0.106312	7.302773	0.0000
PHEX	-0.003365	0.000941	-3.575687	0.0012
R-squared	0.987969	Mean dependent var		17.09876
Adjusted R-squared	0.986028	S.D. dependent var		0.411809
S.E. of regression	0.048677	Akaike info criterion		-3.059842
Sum squared resid	0.073452	Schwarz criterion		-2.798612
Log likelihood	62.60707	F-statistic		509.1282
Durbin-Watson stat	1.015294	Prob(F-statistic)		0.000000

USA				
Dependent Variable: LNHEX				
Method: Least Squares				
Sample(adjusted): 1961 1996				
Included observations: 36 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.243938	0.502170	18.40797	0.0000
LNC	2.045648	0.143829	14.22279	0.0000
DEFICIT	-6.64E-05	2.40E-05	-2.769683	0.0097
PHRMPCT	-0.009798	0.003689	-2.656017	0.0127
DEFPCT	-1.48E-07	2.49E-06	-0.059422	0.9530
PHYSICIAN	0.303206	0.168500	1.799443	0.0824
PHEX	0.000253	0.001412	0.178958	0.8592
R-squared	0.996680	Mean dependent var		19.85160
Adjusted R-squared	0.995993	S.D. dependent var		0.589250
S.E. of regression	0.037298	Akaike info criterion		-3.567092
Sum squared resid	0.040343	Schwarz criterion		-3.259186
Log likelihood	71.20766	F-statistic		1451.116
Durbin-Watson stat	1.064992	Prob(F-statistic)		0.000000

Notes: [1] Period under investigation is 1960 – 1997.

[2] Dependent variable is always the Log of health care expenditures in constant 1995 national currency units.

[3] Last right hand column in each country table indicates levels of significance for each variable.

Table 6-11 Results of co-integration analysis with GDP as a regressor

Austria

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.028248	0.039186	-0.720870	0.4774
D(LNGDP)	1.266002	0.507061	2.496747	0.0192
D(LNGDP(-1))	0.709820	0.498769	1.423144	0.1666
D(PHRMPCT)	0.002570	0.001274	2.017902	0.0540
D(PHRMPCT(-1))	0.002772	0.001244	2.228519	0.0347
D(PHEX)	0.007856	0.008268	0.950155	0.3508
D(PHEX (-1))	-0.004002	0.008804	-0.454530	0.6532
D(DEFICIT)	-1.37E-05	3.42E-06	-4.001927	0.0005
ECT[1]	0.244156	0.127757	1.911103	0.0671

R-squared	0.514551	Mean dependent var	0.048670
Adjusted R-squared	0.365182	S.D. dependent var	0.052902
S.E. of regression	0.042150	Akaike info criterion	-3.278122
Sum squared resid	0.046193	Schwarz criterion	-2.878176
Log likelihood	66.36714	F-statistic	3.444837
Durbin-Watson stat	1.657732	Prob(F-statistic)	0.007797

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030712	0.034703	0.884990	0.3846
D(LNGDP)	0.980806	0.439189	2.233224	0.0347
D(LNGDP(-1))	-0.267421	0.456995	-0.585173	0.5637
D(PHRMPCT)	-0.002218	0.001191	-1.862598	0.0743
D(PHRMPCT(-1))	-0.000414	0.001225	-0.337682	0.7384
D(PHEX)	-0.010792	0.008398	-1.284984	0.2106
D(PHEX (-1))	0.008427	0.008738	0.964396	0.3441
D(DEFPCT)	1.20E-05	1.79E-05	0.674259	0.5063
ECT	0.914199	0.178717	5.115358	0.0000
ECT (-1)	-0.949359	0.182444	-5.203576	0.0000

R-squared	0.630593	Mean dependent var	0.048670
Adjusted R-squared	0.497607	S.D. dependent var	0.052902
S.E. of regression	0.037497	Akaike info criterion	-3.494155
Sum squared resid	0.035151	Schwarz criterion	-3.049770
Log likelihood	71.14771	F-statistic	4.741786
Durbin-Watson stat	1.632239	Prob(F-statistic)	0.000960

Belgium

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001339	0.014699	-0.091077	0.9281
D(LNGDP)	0.089480	0.311805	0.286975	0.7763
D(LNGDP(-1))	1.324619	0.326592	4.055877	0.0004
D(DEFICIT(-1))	-1.89E-06	8.43E-07	-2.241045	0.0334
D(PHRMPCT)	-0.002661	0.001628	-1.635183	0.1136
D(PHRMPCT(-1))	-0.003104	0.001594	-1.947191	0.0620
D(PHYSICIAN)	0.174616	0.088034	1.983518	0.0576
ECT	0.278827	0.143069	1.948901	0.0618

R-squared	0.480092	Mean dependent var	0.051435
Adjusted R-squared	0.345300	S.D. dependent var	0.043158
S.E. of regression	0.034921	Akaike info criterion	-3.673853
Sum squared resid	0.032925	Schwarz criterion	-3.318345
Log likelihood	72.29243	F-statistic	3.561746
Durbin-Watson stat	1.647657	Prob(F-statistic)	0.007684

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.015855	0.030379	-0.521911	0.6060
D(LNGDP)	0.355807	0.421438	0.844267	0.4059
D(LNGDP(-1))	1.213848	0.354821	3.421016	0.0020
D(PHRMPCT)	-0.002312	0.001755	-1.317228	0.1988
D(PHRMPCT(-1))	-0.002837	0.001712	-1.657086	0.1091
D(PHEX)	0.004872	0.006355	0.766651	0.4499
D(PHYSICIAN)	0.154500	0.094743	1.630738	0.1146
ECT	0.281410	0.155547	1.809171	0.0816

R-squared	0.396520	Mean dependent var	0.051435
Adjusted R-squared	0.240062	S.D. dependent var	0.043158
S.E. of regression	0.037623	Akaike info criterion	-3.524793
Sum squared resid	0.038217	Schwarz criterion	-3.169285
Log likelihood	69.68388	F-statistic	2.534358
Durbin-Watson stat	1.616569	Prob(F-statistic)	0.038464

Denmark

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.112755	0.035936	3.137685	0.0039
D(LNGDP(-1))	0.406684	0.824522	0.493236	0.6256
D(PHRMPCT(-1))	-0.002061	0.001648	-1.251021	0.2209
D(PHEX)	-0.030501	0.008026	-3.800114	0.0007
D(DEFICIT(-1))	1.78E-07	4.63E-06	0.038362	0.9697
ECT	0.493318	0.116002	4.252668	0.0002

R-squared	0.514028	Mean dependent var	0.043808
Adjusted R-squared	0.430240	S.D. dependent var	0.074534
S.E. of regression	0.056260	Akaike info criterion	-2.762859
Sum squared resid	0.091791	Schwarz criterion	-2.496228
Log likelihood	54.35004	F-statistic	6.134849
Durbin-Watson stat	1.478800	Prob(F-statistic)	0.000541

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.120567	0.036924	3.265231	0.0029
D(LNGDP)	-0.091015	0.759484	-0.119838	0.9055
D(LNGDP(-1))	0.476547	0.366767	1.299319	0.2044
D(PHRMPCT)	0.000880	0.001940	0.453658	0.6536
D(PHEX)	-0.031872	0.007943	-4.012442	0.0004
D(PHYSICIAN)	-0.060167	0.136166	-0.441865	0.6620
D(DEFICIT)	-5.10E-06	4.87E-06	-1.046133	0.3044
ECT	0.466029	0.136549	3.412899	0.0020

R-squared	0.530458	Mean dependent var	0.045352
Adjusted R-squared	0.413072	S.D. dependent var	0.074043
S.E. of regression	0.056725	Akaike info criterion	-2.708059
Sum squared resid	0.090098	Schwarz criterion	-2.356166
Log likelihood	56.74507	F-statistic	4.518936
Durbin-Watson stat	1.708364	Prob(F-statistic)	0.001779

Finland

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001149	0.025040	-0.045867	0.9637
D(LNGDP)	8.208430	3.632229	2.259888	0.0318
D(LNGDP(-1))	0.744118	0.348504	2.135177	0.0416
D(PHRMPCT)	0.003697	0.001646	2.246683	0.0327
D(DEFICIT(-1))	2.16E-06	4.33E-06	0.498718	0.6219
DELTAGDP	-0.079348	0.035272	-2.249606	0.0325
D(PHEX)	-0.002311	0.003377	-0.684246	0.4994
ECT	0.434954	0.176111	2.469776	0.0199

R-squared	0.453619	Mean dependent var	0.048547
Adjusted R-squared	0.317024	S.D. dependent var	0.043058
S.E. of regression	0.035584	Akaike info criterion	-3.640688
Sum squared resid	0.035455	Schwarz criterion	-3.288795
Log likelihood	73.53239	F-statistic	3.320897
Durbin-Watson stat	1.427803	Prob(F-statistic)	0.010597

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002249	0.025296	-0.088891	0.9298
D(LNGDP)	7.426252	3.647254	2.036121	0.0517
D(LNGDP(-1))	0.952757	0.363311	2.622430	0.0142
D(PHRMPCT(-1))	0.003488	0.001484	2.350415	0.0263
D(DEFICIT(-1))	3.18E-06	4.31E-06	0.737126	0.4674
DELTAGDP	-0.073110	0.035619	-2.052551	0.0499
D(PHEX)	-0.001890	0.003582	-0.527650	0.6021
ECT	0.402373	0.176029	2.285831	0.0303

R-squared	0.459942	Mean dependent var	0.047852
Adjusted R-squared	0.319927	S.D. dependent var	0.043481
S.E. of regression	0.035858	Akaike info criterion	-3.620888
Sum squared resid	0.034716	Schwarz criterion	-3.265380
Log likelihood	71.36554	F-statistic	3.284950
Durbin-Watson stat	1.840876	Prob(F-statistic)	0.011718

France

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.011126	0.011947	0.931351	0.3591
D(LNGDP)	0.687444	0.232902	2.951639	0.0061
D(LNGDP(-1))	0.570089	0.222890	2.557718	0.0158
D(PHRMPCT)	0.000980	0.000493	1.987635	0.0560
D(PHEX)	0.000645	0.002610	0.247098	0.8065
ECT	0.586432	0.188034	3.118760	0.0040

R-squared	0.635066	Mean dependent var	0.051786
Adjusted R-squared	0.574244	S.D. dependent var	0.029368
S.E. of regression	0.019162	Akaike info criterion	-4.920719
Sum squared resid	0.011016	Schwarz criterion	-4.656799
Log likelihood	94.57294	F-statistic	10.44134
Durbin-Watson stat	1.638141	Prob(F-statistic)	0.000007

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004888	0.010549	0.463376	0.6466
D(LNGDP)	1.067951	0.233161	4.580316	0.0001
D(LNGDP(-1))	0.370819	0.202889	1.827696	0.0779
D(PHRMPCT)	0.000729	0.000435	1.674845	0.1047
D(PHEX)	0.000405	0.002268	0.178611	0.8595
D(DEFICIT)	-1.07E-05	3.26E-06	-3.281586	0.0027
ECT	0.626081	0.163761	3.823143	0.0006

R-squared	0.733885	Mean dependent var	0.051786
Adjusted R-squared	0.678827	S.D. dependent var	0.029368
S.E. of regression	0.016643	Akaike info criterion	-5.180951
Sum squared resid	0.008033	Schwarz criterion	-4.873044
Log likelihood	100.2571	F-statistic	13.32924
Durbin-Watson stat	1.998842	Prob(F-statistic)	0.000000

Germany				
Model 1				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1962 1997				
Included observations: 36 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004297	0.021134	0.203309	0.8404
D(LNGDP)	0.955887	0.319773	2.989264	0.0058
D(LNGDP(-1))	0.347108	0.204044	1.701138	0.1000
D(PHYSICIAN)	-0.203622	0.111581	-1.824875	0.0787
D(DEFPCT)	2.13E-05	1.71E-05	1.243758	0.2239
D(PHRMPCT)	0.002041	0.001062	1.922073	0.0648
D(PHEX)	0.010163	0.006100	1.665986	0.1069
ECT	0.173129	0.153065	1.131080	0.2676
R-squared	0.490250	Mean dependent var		0.044800
Adjusted R-squared	0.362812	S.D. dependent var		0.038875
S.E. of regression	0.031032	Akaike info criterion		-3.914487
Sum squared resid	0.026963	Schwarz criterion		-3.562594
Log likelihood	78.46077	F-statistic		3.846976
Durbin-Watson stat	1.691931	Prob(F-statistic)		0.004737
Model 2				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1962 1997				
Included observations: 36 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.019891	0.017173	1.158275	0.2562
D(LNGDP)	0.651881	0.208118	3.132262	0.0039
D(LNGDP(-1))	0.366949	0.205329	1.787124	0.0844
D(PHYSICIAN)	-0.222573	0.111574	-1.994849	0.0555
D(PHRMPCT)	0.002257	0.001058	2.133739	0.0414
D(PHEX)	0.006592	0.005433	1.213319	0.2348
ECT	0.186471	0.154122	1.209893	0.2361
R-squared	0.462087	Mean dependent var		0.044800
Adjusted R-squared	0.350795	S.D. dependent var		0.038875
S.E. of regression	0.031323	Akaike info criterion		-3.916268
Sum squared resid	0.028453	Schwarz criterion		-3.608361
Log likelihood	77.49282	F-statistic		4.152010
Durbin-Watson stat	1.466365	Prob(F-statistic)		0.003947

The Netherlands

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.007851	0.013159	-0.596638	0.5557
D(LNGDP)	0.904732	0.283241	3.194216	0.0036
D(LNGDP(-1))	0.906108	0.246951	3.669176	0.0011
D(PHRMPCT(-1))	0.000106	0.000233	0.455997	0.6520
D(PHEX)	0.004050	0.002771	1.461727	0.1554
D(PHYSICIAN)	-0.156516	0.101928	-1.535565	0.1363
D(DEFICIT)	-2.30E-05	1.39E-05	-1.656730	0.1092
ECT	0.255114	0.137991	1.848771	0.0755

R-squared	0.635470	Mean dependent var	0.052866
Adjusted R-squared	0.540962	S.D. dependent var	0.037384
S.E. of regression	0.025329	Akaike info criterion	-4.316129
Sum squared resid	0.017322	Schwarz criterion	-3.960621
Log likelihood	83.53226	F-statistic	6.724001
Durbin-Watson stat	1.479285	Prob(F-statistic)	0.000117

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.008148	0.013562	-0.600785	0.5528
D(LNGDP)	0.792703	0.283491	2.796225	0.0092
D(LNGDP(-1))	0.914378	0.254477	3.593161	0.0012
D(PHRMPCT(-1))	3.66E-05	0.000236	0.155112	0.8778
D(PHEX)	0.004584	0.002836	1.616239	0.1173
D(PHYSICIAN)	-0.106367	0.100316	-1.060323	0.2981
ECT	0.200223	0.138065	1.450208	0.1581

R-squared	0.598413	Mean dependent var	0.052866
Adjusted R-squared	0.512359	S.D. dependent var	0.037384
S.E. of regression	0.026106	Akaike info criterion	-4.276456
Sum squared resid	0.019082	Schwarz criterion	-3.965386
Log likelihood	81.83798	F-statistic	6.953893
Durbin-Watson stat	1.439273	Prob(F-statistic)	0.000133

Spain

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.038192	0.032040	1.192019	0.2440
D(LNGDP)	0.964049	0.405436	2.377807	0.0251
D(LNGDP(-1))	0.859688	0.370351	2.321281	0.0284
D(PHRMPCT)	0.001120	0.001517	0.738505	0.4668
D(PHRMPCT(-1))	0.001588	0.001488	1.067589	0.2955
D(PHEX (-1))	-0.010592	0.005062	-2.092567	0.0463
D(PHYSICIAN)	0.027509	0.096805	0.284171	0.7785
D(DEFICIT)	-2.35E-07	4.30E-07	-0.546941	0.5891
ECT	0.391814	0.178889	2.190261	0.0377

R-squared	0.740113	Mean dependent var	0.076664
Adjusted R-squared	0.660147	S.D. dependent var	0.064523
S.E. of regression	0.037615	Akaike info criterion	-3.505785
Sum squared resid	0.036787	Schwarz criterion	-3.105838
Log likelihood	70.35123	F-statistic	9.255417
Durbin-Watson stat	1.862540	Prob(F-statistic)	0.000006

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.038192	0.032040	1.192019	0.2440
D(LNGDP)	0.964049	0.405436	2.377807	0.0251
D(LNGDP(-1))	0.859688	0.370351	2.321281	0.0284
D(PHRMPCT)	0.001120	0.001517	0.738505	0.4668
D(PHRMPCT(-1))	0.001588	0.001488	1.067589	0.2955
D(PHEX (-1))	-0.010592	0.005062	-2.092567	0.0463
D(PHYSICIAN)	0.027509	0.096805	0.284171	0.7785
D(DEFICIT)	-2.35E-07	4.30E-07	-0.546941	0.5891
ECT	0.391814	0.178889	2.190261	0.0377

R-squared	0.740113	Mean dependent var	0.076664
Adjusted R-squared	0.660147	S.D. dependent var	0.064523
S.E. of regression	0.037615	Akaike info criterion	-3.505785
Sum squared resid	0.036787	Schwarz criterion	-3.105838
Log likelihood	70.35123	F-statistic	9.255417
Durbin-Watson stat	1.862540	Prob(F-statistic)	0.000006

Sweden				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030934	0.011092	2.788871	0.0100
D(LNGDP)	0.729717	0.259705	2.809789	0.0095
D(LNGDP(-1))	0.610096	0.268332	2.273663	0.0318
D(PHRMPCT)	-0.004610	0.001276	-3.614282	0.0013
D(PHRMPCT(-1))	-0.000571	0.001059	-0.539297	0.5945
D(PHEX)	-0.007938	0.001668	-4.758996	0.0001
D(PHEX (-1))	-0.001739	0.001590	-1.093395	0.2846
D(DEFICIT(-1))	-3.88E-06	1.28E-06	-3.040615	0.0055
ECT	0.612784	0.112046	5.469037	0.0000
ECT (-1)	-0.473461	0.105103	-4.504720	0.0001
R-squared	0.717296	Mean dependent var		0.039707
Adjusted R-squared	0.615523	S.D. dependent var		0.039574
S.E. of regression	0.024538	Akaike info criterion		-4.342220
Sum squared resid	0.015053	Schwarz criterion		-3.897835
Log likelihood	85.98885	F-statistic		7.047983
Durbin-Watson stat	1.558126	Prob(F-statistic)		0.000051

Switzerland

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009696	0.007763	1.248999	0.2220
D(LNGDP)	1.100393	0.110287	9.977507	0.0000
D(LNGDP(-1))	0.435536	0.110417	3.944473	0.0005
D(PHRMPCT)	0.000672	0.000205	3.282400	0.0028
D(PHEX (-1))	0.012602	0.002311	5.453677	0.0000
D(PHYSICIAN)	-0.725780	0.053830	-13.48282	0.0000
ECT	0.881299	0.048476	18.18025	0.0000
ECT (-1)	-0.881567	0.048697	-18.10314	0.0000

R-squared	0.950410	Mean dependent var	0.054325
Adjusted R-squared	0.938013	S.D. dependent var	0.042761
S.E. of regression	0.010646	Akaike info criterion	-6.054093
Sum squared resid	0.003174	Schwarz criterion	-5.702200
Log likelihood	116.9737	F-statistic	76.66183
Durbin-Watson stat	1.960885	Prob(F-statistic)	0.000000

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.029263	0.007852	3.726934	0.0009
D(LNGDP)	1.204543	0.135607	8.882600	0.0000
D(PHRMPCT)	0.000662	0.000259	2.553187	0.0164
D(PHEX (-1))	0.007233	0.002418	2.991730	0.0057
D(PHYSICIAN)	-0.715011	0.067150	-10.64802	0.0000
D(DEFICIT)	1.22E-06	6.05E-06	0.201317	0.8419
ECT	0.872524	0.060538	14.41274	0.0000
ECT (-1)	-0.953514	0.057476	-16.58980	0.0000

R-squared	0.922966	Mean dependent var	0.054325
Adjusted R-squared	0.903708	S.D. dependent var	0.042761
S.E. of regression	0.013269	Akaike info criterion	-5.613631
Sum squared resid	0.004930	Schwarz criterion	-5.261738
Log likelihood	109.0454	F-statistic	47.92514
Durbin-Watson stat	0.954954	Prob(F-statistic)	0.000000

UK

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.028728	0.011554	2.486385	0.0197
D(LNGDP)	0.096409	0.234988	0.410274	0.6850
D(LNGDP(-1))	0.579450	0.230409	2.514877	0.0184
D(PHRMPCT)	0.002936	0.001502	1.954744	0.0614
D(PHRMPCT(-1))	0.001893	0.001734	1.092202	0.2848
D(PHYSICIAN)	0.037970	0.095561	0.397339	0.6944
D(PHEX (-1))	-0.002429	0.001582	-1.535829	0.1367
D(DEFICIT)	-7.71E-05	2.81E-05	-2.743836	0.0109
ECT	0.339892	0.173036	1.964286	0.0603

R-squared	0.452678	Mean dependent var	0.038342
Adjusted R-squared	0.284272	S.D. dependent var	0.023507
S.E. of regression	0.019887	Akaike info criterion	-4.780417
Sum squared resid	0.010283	Schwarz criterion	-4.380470
Log likelihood	92.65730	F-statistic	2.688007
Durbin-Watson stat	2.114842	Prob(F-statistic)	0.026791

USA

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1996
Included observations: 34 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.019632	0.006995	2.806798	0.0098
D(LNGDP)	1.220868	0.152776	7.991228	0.0000
D(LNGDP(-1))	0.037167	0.073518	0.505557	0.6178
D(PHRMPCT)	-0.005687	0.001072	-5.303893	0.0000
D(PHRMPCT(-1))	1.30E-05	0.000731	0.017788	0.9860
D(PHEX (-1))	0.002183	0.001131	1.930198	0.0655
D(PHYSICIAN)	-0.044754	0.024721	-1.810371	0.0828
D(DEFICIT)	-8.97E-05	1.07E-05	-8.385325	0.0000
ECT	0.687357	0.092556	7.426413	0.0000
ECT (-1)	-0.751384	0.081147	-9.259597	0.0000

R-squared	0.833373	Mean dependent var	0.056217
Adjusted R-squared	0.770888	S.D. dependent var	0.014976
S.E. of regression	0.007168	Akaike info criterion	-6.798351
Sum squared resid	0.001233	Schwarz criterion	-6.349421
Log likelihood	125.5720	F-statistic	13.33716
Durbin-Watson stat	2.427031	Prob(F-statistic)	0.000000

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1996
Included observations: 34 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.069867	0.010077	6.933624	0.0000
D(LNGDP)	-0.133346	0.214158	-0.622653	0.5392
D(DELTAGDP)	0.000594	0.001633	0.363572	0.7192
D(PHRMPCT)	0.000761	0.001769	0.430078	0.6708
D(PHRMPCT(-1))	-0.001113	0.001564	-0.711534	0.4833
D(PHEX)	-0.001127	0.006177	-0.182400	0.8567
D(PHEX (-1))	-0.002256	0.006081	-0.371034	0.7137
D(PHYSICIAN)	-0.043224	0.053875	-0.802306	0.4299
ECT	-0.072089	0.112587	-0.640294	0.5278

R-squared	0.192729	Mean dependent var	0.056217
Adjusted R-squared	-0.065598	S.D. dependent var	0.014976
S.E. of regression	0.015459	Akaike info criterion	-5.279271
Sum squared resid	0.005975	Schwarz criterion	-4.875235
Log likelihood	98.74761	F-statistic	0.746066
Durbin-Watson stat	0.943127	Prob(F-statistic)	0.651260

Note: [1] ECT: Error Correction Term.

Table 6-12 Results of co-integration analysis with consumption as a regressor

Austria				
Model 1				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012723	0.033043	0.385041	0.7033
D(LNC)	0.817320	0.452444	1.806456	0.0824
D(LNC(-1))	0.314063	0.467397	0.671941	0.5075
D(PHRMPCT)	0.002476	0.001406	1.761025	0.0900
D(PHRMPCT(-1))	0.003434	0.001266	2.712343	0.0117
D(PHEX)	0.009801	0.008589	1.141024	0.2643
D(PHEX(-1))	-0.008348	0.008507	-0.981345	0.3355
D(DEFICIT)	-6.99E-06	3.71E-06	-1.884568	0.0707
ECT[1]	0.131301	0.060029	2.187274	0.0379
R-squared	0.444002	Mean dependent var		0.048670
Adjusted R-squared	0.272926	S.D. dependent var		0.052902
S.E. of regression	0.045109	Akaike info criterion		-3.142432
Sum squared resid	0.052906	Schwarz criterion		-2.742485
Log likelihood	63.99256	F-statistic		2.595348
Durbin-Watson stat	1.657976	Prob(F-statistic)		0.031316
Model 2				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000238	0.033812	-0.007030	0.9944
D(LNC)	1.037071	0.457350	2.267564	0.0316
D(LNC(-1))	0.235414	0.487031	0.483365	0.6327
D(PHRMPCT)	0.001515	0.001371	1.105034	0.2789
D(PHRMPCT(-1))	0.003356	0.001324	2.535146	0.0173
D(PHEX)	0.010799	0.008969	1.204043	0.2390
D(PHEX (-1))	-0.005092	0.008714	-0.584298	0.5639
ECT	0.162682	0.060337	2.696195	0.0119
R-squared	0.368053	Mean dependent var		0.048670
Adjusted R-squared	0.204215	S.D. dependent var		0.052902
S.E. of regression	0.047192	Akaike info criterion		-3.071533
Sum squared resid	0.060132	Schwarz criterion		-2.716025
Log likelihood	61.75184	F-statistic		2.246444
Durbin-Watson stat	1.621122	Prob(F-statistic)		0.061535

Belgium				
Model 1				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008107	0.014252	0.568863	0.5742
D(LNC)	0.525931	0.422876	1.243699	0.2243
D(LNC(-1))	1.203120	0.447106	2.690907	0.0121
D(PHRMPCT)	-0.002931	0.001713	-1.710935	0.0986
D(PHRMPCT(-1))	-0.002528	0.001685	-1.499903	0.1452
D(DELTAGDP)	-0.005265	0.002635	-1.998374	0.0558
D(DEFICIT(-1))	-1.13E-06	8.87E-07	-1.269011	0.2153
ECT	0.345849	0.162861	2.123578	0.0430

R-squared	0.421060	Mean dependent var	0.051435
Adjusted R-squared	0.270965	S.D. dependent var	0.043158
S.E. of regression	0.036850	Akaike info criterion	-3.566308
Sum squared resid	0.036663	Schwarz criterion	-3.210800
Log likelihood	70.41038	F-statistic	2.805282
Durbin-Watson stat	1.684497	Prob(F-statistic)	0.024874

Denmark

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.087414	0.025655	3.407348	0.0019
D(LNC)	-0.244487	0.490575	-0.498369	0.6220
D(LNC(-1))	0.832749	0.460571	1.808078	0.0810
D(PHRMPCT)	0.004323	0.001947	2.220043	0.0344
D(PHEX)	-0.023767	0.007668	-3.099459	0.0043
D(PHYSICIAN)	0.180802	0.139060	1.300172	0.2038
D(DEFICIT)	-9.97E-06	4.92E-06	-2.025584	0.0521

R-squared	0.399446	Mean dependent var	0.045352
Adjusted R-squared	0.275193	S.D. dependent var	0.074043
S.E. of regression	0.063037	Akaike info criterion	-2.517520
Sum squared resid	0.115237	Schwarz criterion	-2.209614
Log likelihood	52.31537	F-statistic	3.214789
Durbin-Watson stat	1.844234	Prob(F-statistic)	0.015209

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.090503	0.023692	3.819947	0.0007
D(LNC)	-0.245659	0.452419	-0.542991	0.5914
D(LNC(-1))	1.219481	0.452701	2.693791	0.0118
D(PHRMPCT)	0.003348	0.001839	1.821123	0.0793
D(PHEX)	-0.027384	0.007222	-3.791874	0.0007
D(PHYSICIAN)	0.185622	0.128259	1.447237	0.1589
D(DEFICIT)	-1.04E-05	4.54E-06	-2.284504	0.0301
ECT	0.254387	0.103016	2.469396	0.0199

R-squared	0.506846	Mean dependent var	0.045352
Adjusted R-squared	0.383558	S.D. dependent var	0.074043
S.E. of regression	0.058134	Akaike info criterion	-2.658997
Sum squared resid	0.094628	Schwarz criterion	-2.307104
Log likelihood	55.86194	F-statistic	4.111061
Durbin-Watson stat	1.789597	Prob(F-statistic)	0.003203

Finland

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.031522	0.011272	2.796420	0.0096
D(LNC)	0.449339	0.158470	2.835485	0.0087
D(LNC(-1))	0.889268	0.180914	4.915427	0.0000
D(PHRMPCT)	0.004540	0.000967	4.694811	0.0001
D(PHEX)	0.004538	0.003422	1.326331	0.1963
D(PHEX (-1))	-0.006630	0.003597	-1.842991	0.0768
D(DEFICIT)	-6.71E-07	2.15E-06	-0.312086	0.7575
D(PHYSICIAN)	-0.140257	0.073106	-1.918551	0.0661
ECT	0.660921	0.104719	6.311398	0.0000
ECT (-1)	-0.638020	0.088435	-7.214547	0.0000

R-squared	0.824040	Mean dependent var	0.048547
Adjusted R-squared	0.763130	S.D. dependent var	0.043058
S.E. of regression	0.020956	Akaike info criterion	-4.662636
Sum squared resid	0.011418	Schwarz criterion	-4.222769
Log likelihood	93.92744	F-statistic	13.52895
Durbin-Watson stat	1.613564	Prob(F-statistic)	0.000000

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.031792	0.011049	2.877321	0.0077
D(LNC)	0.436870	0.150765	2.897684	0.0074
D(LNC(-1))	0.886527	0.177654	4.990180	0.0000
D(PHRMPCT)	0.004617	0.000919	5.023770	0.0000
D(PHEX)	0.004268	0.003254	1.311429	0.2008
D(PHEX (-1))	-0.006239	0.003315	-1.881897	0.0707
D(PHYSICIAN)	-0.142759	0.071440	-1.998317	0.0558
ECT	0.668836	0.099889	6.695817	0.0000
ECT (-1)	-0.641243	0.086350	-7.426106	0.0000

R-squared	0.823381	Mean dependent var	0.048547
Adjusted R-squared	0.771049	S.D. dependent var	0.043058
S.E. of regression	0.020603	Akaike info criterion	-4.714452
Sum squared resid	0.011461	Schwarz criterion	-4.318572
Log likelihood	93.86014	F-statistic	15.73388
Durbin-Watson stat	1.587798	Prob(F-statistic)	0.000000

France

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003517	0.010998	0.319784	0.7514
D(LNC)	1.351456	0.247045	5.470490	0.0000
D(LNC(-1))	0.641028	0.226307	2.832555	0.0083
D(PHRMPCT)	0.000861	0.000435	1.979950	0.0573
D(PHEX (-1))	-0.000237	0.002097	-0.113186	0.9107
D(DEFICIT)	-7.45E-06	2.96E-06	-2.517977	0.0176
ECT	0.668052	0.168578	3.962856	0.0004

R-squared	0.728334	Mean dependent var	0.051786
Adjusted R-squared	0.672127	S.D. dependent var	0.029368
S.E. of regression	0.016816	Akaike info criterion	-5.160306
Sum squared resid	0.008201	Schwarz criterion	-4.852400
Log likelihood	99.88551	F-statistic	12.95813
Durbin-Watson stat	2.006869	Prob(F-statistic)	0.000000

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.009130	0.011689	0.781071	0.4409
D(LNC)	1.152657	0.254071	4.536751	0.0001
D(LNC(-1))	0.679563	0.245063	2.773017	0.0095
D(PHRMPCT)	0.001058	0.000464	2.278787	0.0300
D(PHEX (-1))	-0.000587	0.002271	-0.258520	0.7978
ECT	0.601183	0.180684	3.327269	0.0023

R-squared	0.668940	Mean dependent var	0.051786
Adjusted R-squared	0.613764	S.D. dependent var	0.029368
S.E. of regression	0.018251	Akaike info criterion	-5.018136
Sum squared resid	0.009993	Schwarz criterion	-4.754216
Log likelihood	96.32645	F-statistic	12.12362
Durbin-Watson stat	1.790520	Prob(F-statistic)	0.000002

Germany				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1962 1997				
Included observations: 36 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.030927	0.015722	1.967134	0.0588
D(LNC)	1.030362	0.307310	3.352838	0.0022
D(PHYSICIAN)	-0.177481	0.098687	-1.798412	0.0825
D(DEFPCT)	5.34E-06	1.24E-05	0.431726	0.6691
D(PHRMPCT)	0.001924	0.000838	2.296447	0.0291
D(PHEX)	0.001608	0.004501	0.357159	0.7236
ECT	0.268846	0.089397	3.007329	0.0054

R-squared	0.567659	Mean dependent var	0.044800
Adjusted R-squared	0.478210	S.D. dependent var	0.038875
S.E. of regression	0.028081	Akaike info criterion	-4.134751
Sum squared resid	0.022868	Schwarz criterion	-3.826844
Log likelihood	81.42551	F-statistic	6.346124
Durbin-Watson stat	1.545707	Prob(F-statistic)	0.000238

The Netherlands

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.020806	0.009992	2.082262	0.0466
D(LNC)	0.610389	0.190122	3.210519	0.0033
D(LNC(-1))	0.960568	0.189578	5.066864	0.0000
D(PHRMPCT)	7.31E-06	0.000239	0.030642	0.9758
D(PHEX)	-0.001339	0.002679	-0.499760	0.6211
D(PHYSICIAN)	-0.105485	0.095522	-1.104306	0.2789
D(DEFICIT)	-2.04E-05	1.37E-05	-1.487218	0.1481
ECT	0.380543	0.103140	3.689563	0.0010

R-squared	0.620306	Mean dependent var	0.053920
Adjusted R-squared	0.525382	S.D. dependent var	0.037385
S.E. of regression	0.025756	Akaike info criterion	-4.287196
Sum squared resid	0.018574	Schwarz criterion	-3.935303
Log likelihood	85.16953	F-statistic	6.534795
Durbin-Watson stat	1.329328	Prob(F-statistic)	0.000128

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1962 1997
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.001141	0.002451	-0.465303	0.6453
D(LNC)	2.097603	0.077782	26.96755	0.0000
D(LNC(-1))	-0.037589	0.059725	-0.629367	0.5342
D(PHRMPCT)	0.000149	5.32E-05	2.796309	0.0092
D(PHEX)	0.006076	0.000670	9.068655	0.0000
D(PHYSICIAN)	-0.286635	0.023267	-12.31960	0.0000
ECT	0.986596	0.035662	27.66491	0.0000
ECT (-1)	-1.011809	0.043248	-23.39562	0.0000

R-squared	0.980062	Mean dependent var	0.053920
Adjusted R-squared	0.975078	S.D. dependent var	0.037385
S.E. of regression	0.005902	Akaike info criterion	-7.233950
Sum squared resid	0.000975	Schwarz criterion	-6.882057
Log likelihood	138.2111	F-statistic	196.6250
Durbin-Watson stat	2.182371	Prob(F-statistic)	0.000000

Spain

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1964 1997
Included observations: 34 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.108853	0.015949	6.825042	0.0000
D(LNC)	0.447283	0.187781	2.381937	0.0248
D(LNC(-1))	0.291379	0.174197	1.672701	0.1064
D(PHRMPCT)	0.001202	0.001412	0.851672	0.4022
D(PHRMPCT(-1))	0.001831	0.001372	1.334448	0.1936
D(PHEX (-1))	-0.018056	0.003560	-5.071657	0.0000
D(DEFICIT(-1))	9.14E-07	4.15E-07	2.201254	0.0368
ECT	0.088676	0.073401	1.208107	0.2379

R-squared	0.764624	Mean dependent var	0.074734
Adjusted R-squared	0.701253	S.D. dependent var	0.064460
S.E. of regression	0.035233	Akaike info criterion	-3.651362
Sum squared resid	0.032275	Schwarz criterion	-3.292219
Log likelihood	70.07316	F-statistic	12.06591
Durbin-Watson stat	1.666634	Prob(F-statistic)	0.000001

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.100526	0.016405	6.127775	0.0000
D(LNC)	0.420359	0.191414	2.196074	0.0365
D(LNC(-1))	0.342063	0.179425	1.906442	0.0669
D(PHRMPCT)	0.001984	0.001454	1.364420	0.1833
D(PHRMPCT(-1))	0.002249	0.001442	1.559677	0.1301
D(PHEX (-1))	-0.016645	0.003720	-4.474225	0.0001
ECT	0.039308	0.067709	0.580541	0.5662

R-squared	0.723818	Mean dependent var	0.076664
Adjusted R-squared	0.664637	S.D. dependent var	0.064523
S.E. of regression	0.037366	Akaike info criterion	-3.559261
Sum squared resid	0.039094	Schwarz criterion	-3.248191
Log likelihood	69.28706	F-statistic	12.23043
Durbin-Watson stat	1.931559	Prob(F-statistic)	0.000001

Sweden				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1997				
Included observations: 35 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.005051	0.009092	0.555533	0.5839
D(LNC)	1.866451	0.271815	6.866617	0.0000
D(LNC(-1))	0.944573	0.269314	3.507327	0.0019
D(PHRMPCT)	-0.003595	0.000967	-3.717837	0.0011
D(PHRMPCT(-1))	-0.001176	0.000784	-1.499221	0.1474
D(PHEX)	-0.009825	0.001614	-6.088272	0.0000
D(PHEX(-1))	-0.002771	0.001362	-2.034823	0.0536
D(DEFICIT(-1))	-3.37E-06	9.00E-07	-3.745633	0.0011
D(PHYSICIAN)	0.264231	0.069113	3.823179	0.0009
ECT	0.639861	0.083769	7.638433	0.0000
ECT(-1)	-0.424647	0.117308	-3.619940	0.0014
ECT(-2)	-0.225379	0.073318	-3.074010	0.0054

R-squared	0.871692	Mean dependent var	0.039707
Adjusted R-squared	0.810328	S.D. dependent var	0.039574
S.E. of regression	0.017235	Akaike info criterion	-5.017902
Sum squared resid	0.006832	Schwarz criterion	-4.484640
Log likelihood	99.81329	F-statistic	14.20515
Durbin-Watson stat	1.755267	Prob(F-statistic)	0.000000

Switzerland

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.034081	0.017702	1.925202	0.0652
D(LNC)	0.617766	0.319473	1.933702	0.0641
D(LNC(-1))	0.453987	0.314293	1.444470	0.1606
D(PHRMPCT)	0.000629	0.000683	0.921850	0.3651
D(PHEX (-1))	0.006398	0.005765	1.109726	0.2773
D(PHYSICIAN)	-0.537419	0.166725	-3.223386	0.0034
D(DEFICIT)	-1.72E-05	1.43E-05	-1.203861	0.2395
ECT	0.435964	0.117812	3.700506	0.0010
ECT (-1)	-0.525151	0.125997	-4.167963	0.0003

R-squared	0.494361	Mean dependent var	0.051996
Adjusted R-squared	0.338780	S.D. dependent var	0.041002
S.E. of regression	0.033341	Akaike info criterion	-3.747008
Sum squared resid	0.028903	Schwarz criterion	-3.347061
Log likelihood	74.57264	F-statistic	3.177513
Durbin-Watson stat	2.038135	Prob(F-statistic)	0.011954

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.036383	0.018596	1.956524	0.0617
D(LNC)	0.594771	0.327802	1.814423	0.0816
D(LNC(-1))	0.411520	0.331020	1.243189	0.2253
D(PHRMPCT)	0.000399	0.000843	0.472697	0.6405
D(PHRMPCT(-1))	-0.000397	0.000826	-0.481288	0.6345
D(PHEX (-1))	0.005847	0.005963	0.980673	0.3361
D(PHYSICIAN)	-0.538943	0.169274	-3.183845	0.0039
D(DEFICIT)	-1.80E-05	1.46E-05	-1.231742	0.2295
ECT	0.433561	0.119697	3.622171	0.0013
ECT (-1)	-0.516871	0.129053	-4.005106	0.0005

R-squared	0.499003	Mean dependent var	0.051996
Adjusted R-squared	0.318644	S.D. dependent var	0.041002
S.E. of regression	0.033845	Akaike info criterion	-3.699088
Sum squared resid	0.028637	Schwarz criterion	-3.254703
Log likelihood	74.73404	F-statistic	2.766724
Durbin-Watson stat	2.022957	Prob(F-statistic)	0.021398

UK

Model 1

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.001760	0.003674	0.479079	0.6359
D(LNC)	1.210346	0.100510	12.04202	0.0000
D(PHRMPCT)	0.006622	0.000535	12.38068	0.0000
D(PHRMPCT(-1))	-0.000269	0.000538	-0.500796	0.6207
D(PHYSICIAN)	0.687890	0.049341	13.94146	0.0000
D(PHEX (-1))	-0.002037	0.000477	-4.268960	0.0002
D(DEFICIT)	-0.000133	9.68E-06	-13.78458	0.0000
ECT	0.857056	0.065070	13.17122	0.0000
ECT (-1)	-0.875913	0.052566	-16.66297	0.0000

R-squared	0.940914	Mean dependent var	0.038342
Adjusted R-squared	0.922734	S.D. dependent var	0.023507
S.E. of regression	0.006534	Akaike info criterion	-7.006466
Sum squared resid	0.001110	Schwarz criterion	-6.606519
Log likelihood	131.6131	F-statistic	51.75490
Durbin-Watson stat	2.085616	Prob(F-statistic)	0.000000

Model 2

Dependent Variable: D(LNHEX)
Method: Least Squares
Sample(adjusted): 1963 1997
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.041215	0.006499	6.341564	0.0000
D(LNC)	0.123295	0.160781	0.766847	0.4501
D(LNC(-1))	-0.137176	0.216316	-0.634145	0.5315
D(PHRMPCT)	0.003739	0.001341	2.788606	0.0098
D(PHRMPCT(-1))	-0.000193	0.001523	-0.126598	0.9002
D(PHYSICIAN)	0.201443	0.092173	2.185482	0.0381
D(PHEX (-1))	-0.002641	0.001306	-2.022816	0.0535
D(DEFICIT)	-7.79E-05	2.39E-05	-3.254918	0.0031
ECT (-1)	-0.346071	0.107773	-3.211107	0.0035

R-squared	0.553579	Mean dependent var	0.038342
Adjusted R-squared	0.416219	S.D. dependent var	0.023507
S.E. of regression	0.017961	Akaike info criterion	-4.984192
Sum squared resid	0.008388	Schwarz criterion	-4.584245
Log likelihood	96.22336	F-statistic	4.030127
Durbin-Watson stat	2.387610	Prob(F-statistic)	0.003168

USA				
Model 1				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1996				
Included observations: 34 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.039113	0.010082	3.879336	0.0007
D(LNC)	0.981813	0.265263	3.701278	0.0011
D(LNC(-1))	-0.270781	0.147108	-1.840693	0.0776
D(PHRMPCT)	-0.005474	0.001991	-2.749775	0.0109
D(PHRMPCT(-1))	-0.000927	0.001348	-0.687488	0.4981
D(PHEX)	-0.001438	0.001611	-0.892258	0.3808
D(PHYSICIAN)	0.157838	0.067844	2.326488	0.0284
ECT	0.493900	0.154382	3.199213	0.0037
ECT (-1)	-0.500703	0.137101	-3.652082	0.0012
R-squared	0.484969	Mean dependent var		0.056217
Adjusted R-squared	0.320159	S.D. dependent var		0.014976
S.E. of regression	0.012348	Akaike info criterion		-5.728704
Sum squared resid	0.003812	Schwarz criterion		-5.324667
Log likelihood	106.3880	F-statistic		2.942597
Durbin-Watson stat	1.161612	Prob(F-statistic)		0.018355
Model 2				
Dependent Variable: D(LNHEX)				
Method: Least Squares				
Sample(adjusted): 1963 1996				
Included observations: 34 after adjusting endpoints				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.039747	0.008470	4.692830	0.0001
D(LNC)	0.546857	0.154646	3.536192	0.0017
D(LNC(-1))	0.328530	0.156600	2.097898	0.0466
D(PHRMPCT)	-0.001334	0.001371	-0.972824	0.3403
D(PHRMPCT(-1))	-0.002606	0.001335	-1.951516	0.0628
D(PHEX (-1))	-0.001280	0.001484	-0.862406	0.3970
D(DEFICIT(-1))	-3.31E-05	1.09E-05	-3.047377	0.0055
D(DELTAGDP)	-0.001372	0.001033	-1.327998	0.1967
ECT	0.231618	0.090200	2.567834	0.0169
ECT (-2)	-0.325660	0.084666	-3.846425	0.0008
R-squared	0.568228	Mean dependent var		0.056217
Adjusted R-squared	0.406314	S.D. dependent var		0.014976
S.E. of regression	0.011539	Akaike info criterion		-5.846210
Sum squared resid	0.003196	Schwarz criterion		-5.397280
Log likelihood	109.3856	F-statistic		3.509435
Durbin-Watson stat	1.937937	Prob(F-statistic)		0.006677

Note: [1] ECT: Error Correction Term.

CHAPTER 7 CONCLUSIONS, POLICY IMPLICATIONS AND FUTURE RESEARCH

7.1 Introduction

This thesis has shown that the determinants of health care expenditures are simply too diverse amongst different countries to be brought within a common denominator as implied by the use of exchange rates, purchasing power parities (PPPs), cross-sectional or, even, pooled cross-sectional analysis. Their diversity also implies that the use of GDP does very little in terms of contributing to an understanding of the fundamental issues affecting their size and can potentially offer at most a measure of the impact of the macro economy on health spending. This gives strong credence to the argument that casual empiricism and analytical convenience have preceded methodological correctness.

The thesis has also shown that the assumption that health care is a homogeneous good across countries is an over-simplistic and arbitrary assumption that does not correspond to reality. Furthermore, the thesis has found ample evidence showing that health care is not a luxury good and that GDP is only weakly associated with health spending, instead of being a major determinant of it. In reaching these results, the thesis contributes to knowledge and, ultimately, to the process of health policy-making on methodological, theoretical and empirical grounds as outlined below.

7.2 Methodological contribution

In terms of methodology, the thesis has shown that there are significant flaws in several areas that influence our thinking concerning the determinants of health care expenditures, which were initially thought to be robust, and has offered alternative ways of analysis and appraisal. In particular, flaws were shown to be present in:

(a) The conceptual issues around: (i) the relationship between health expenditure and GDP; (ii) the extent to which GDP and other variables provide robust estimates of the variation in health care expenditures; and (iii) the importance of factors such as ageing, the macroeconomic context and the burden of disease;

(b) The measurement of key variables used in empirical analysis, such as health spending, national income, technology, and health prices;

(c) The method of analysis that has been pursued and the fact that it most frequently entails simultaneously analysing countries which are vastly different from each other;

(d) The conversion factors used to bring translate prices and monetary variables from different countries into a single and comparable denominator.

A more detailed treatment of the above four issues is offered in the sections that follow.

7.2.1 Conceptual issues arising from the literature

The thesis has shown that the Aggregate Health Care Expenditure to GDP relationship is subject to six significant qualifications. The first qualification is related to the method of analysis. A meta-analysis of the literature in chapter 2 showed that the results can be sensitive to the estimation technique used (whether cross-sectional, pooled cross-sectional or time-series). It was shown that although it was common for the income elasticity of demand to exceed unity in bi-variate and multi-variate cross-sectional analyses, it was less common in pooled cross-sectional and time-series studies. Overall, the initial, apparently, overwhelming evidence about the income elasticity of demand for health care being greater than unity faded in subsequent studies, so that hypotheses have been advanced that health care is neither "a necessity" or "a luxury", but, somewhat implausibly, "both" since the income elasticity varies with the level of analysis. Nevertheless, regardless of the value of the elasticity, the literature concluded that income was positively correlated with health expenditure and statistically significant. In contrast, the methodological approach adopted in this thesis demonstrated that even this empirical finding was deeply flawed. It was also shown that the relationship between GDP and health expenditure was not significant in the majority of countries analysed.

Second, whereas factors other than income were identified in the literature to be significant explanatory factors for the variance in health care expenditure, the thesis has examined the robustness of the results obtained and concluded that these are contestable and that the relationships found are inconsistent. This, in turn, reflects the absence of a theoretical framework underpinning the empirical analysis and the multiplicity of hypotheses tested within a single empirical model. Another concern is the use of large numbers of dummy variables in empirical investigations. Authors make excessive use of dummy variables without taking into account the well-known problems related to their use, particularly the problem of inter-relationships between dummies. In addition to the cautious use of dummies, the thesis has shown that systemic variables associated with the measurement of the impact of reforms in certain countries (for example, the impact of the market-oriented reforms in the UK over the 1991 – 1997 period), or associated with exogenous factors having an impact on key variables (such as German re-unification) had remained unaccounted for.

Third, although several of the studies reviewed draw criticism because of misspecification problems and unexplained omissions in the analytical models, further issues remain unresolved. These relate to the actual choice of variables and their comparability across countries and over time. They also relate to the lag structure in individual models, which often appears to be contrary to what (economic) theory would predict. A characteristic example in this context is the relationship between income and health care expenditure. If one accepts the validity of public choice theory, as many authors have done, then current levels of health care expenditure should be determined by past levels of GDP plus the trend of GDP or its growth, rather than current GDP levels. Yet, there has not been a single study in the literature until now that has tested this particular hypothesis.

Fourth, while there appears to be a great deal of concern about the economic interpretation of an elasticity of demand greater or smaller than unity and the robustness of econometric technique in deriving one or the other, what is conspicuous by its absence is the discussion of the policy relevance of the findings obtained and how they could be translated into policy recommendations for individual health systems or groups of health care systems. Similarly, as presented, the empirical cross-country literature has hardly contributed to the policy debate about whether there is an optimal level of resources to be spent on health.

Fifth, with regards to population ageing, several empirical studies have attempted to analyse its effects as a determinant of health spending. A number of *macro-level* studies of the determinants of health care expenditures have included ageing as an explanatory variable and have found a positive and significant relationship between the two. On the other hand, although ageing is an important contributor to social security costs, its true value in pushing health care costs up has been disputed in *micro-level* studies and only a weak association between health expenditure and ageing has been found in the literature. The thesis has advanced the view that ageing, expressed as a proportion of the population over 65, is irrelevant as what really matters is intensity of health service utilisation during the last months of life. The thesis has therefore explicitly excluded ageing as a potential determinant of health care expenditures on conceptual grounds.

Finally, the thesis has discussed other potential determinants of health care expenditures. In doing so, it highlighted the importance of macroeconomic factors, such as the fiscal deficit and total public consumption on goods and services, but also the significance of measures of disease burden, the relevance of consumer expectations about health services and the extent to which expectations shape demand. While some of these variables are measured quite accurately by national statistics (e.g. fiscal deficit, total public consumption), the thesis has strongly criticised the inclusion of lifestyle variables - such as tobacco consumption, alcohol consumption or fat consumption per capita – in empirical analysis on two grounds: first, due to imperfect data, which have significant gaps in the respective time-series, and, second, on the grounds that these variables have been arbitrarily included without proper account of the lag structures involved in the genesis of disease. The thesis has further argued for better data sources and understanding of causal pathways in this area that would facilitate their inclusion in empirical studies. Although the importance of measures of disease burden was acknowledged, current knowledge of their impact on need for health services is still inadequate.

7.2.2 Measurement of variables

The thesis has placed a great deal of attention on the measurement of key variables particularly GDP and health expenditure and has shown that gross disparities exist across available data sources, which make cross-country comparisons within a cross-sectional or pooled cross-sectional setting virtually meaningless. It has also examined the use of technology and health prices, both from a methodological and empirical point of view.

7.2.2.1 On the validity of GDP as a proxy for national income

Whereas the entire body of empirical literature uses GDP as a proxy for income, the thesis has demonstrated that the different systems of national accounts provide non-comparable GDP estimates across countries, yielding biases to all estimates obtained through cross-sectional or pooled cross-sectional analysis. Furthermore, there are certain aspects of economic activity which cannot be captured by GDP in the empirical investigation. One very important aspect is the considerable impact of the parallel economy in a number of (developed) countries and its potential size both in terms of contribution to national income and voluntary contributions for health services. On those grounds, the thesis queried and criticised the use of GDP as a proxy for national income and suggested that total personal consumption should be used as a more representative proxy, since it reflects (household) decisions based on aggregate household income; the latter includes non-financial as well as financial wealth, and may to a certain degree also capture the extent of activities in the shadow economy.

7.2.2.2 On the validity of Health Expenditure measurements

It has been shown that the methodology for measuring health expenditures varies by country, as do accounting practices, often resulting in measurements that provide little basis for comparison across countries. The thesis has argued that any cross-section or pooled cross-section analysis of the determinants of health care expenditures is flawed, in that it implicitly assumes perfect comparability of health care expenditure data and their measurement across countries and over time. The way forward would of course be to standardise the measurement and reporting of health care expenditure data, work that is currently being undertaken by the WHO in its programme to strengthen national health accounts. While this would possibly be the most robust strategy, a country-by-country, time-series analysis of the determinants of health care expenditures would partly address the issue of data comparability across countries.

7.2.2.3 On the validity of technology measurements

The thesis acknowledged the complete absence of "technology" considerations from the empirical (econometric) literature of the determinants of health care expenditures, despite the latter being credited to have been a net and consistent contributor to increasing health care costs in most industrialised countries. Indeed, medical technology has very rarely appeared explicitly in empirical analysis, despite arguments that it is one of the most dynamic components of growth in health spending. This has been due to the inadequacy of data on technology spending and utilisation, as well as the absence of a definition of what is technology. In recognising the imperfections arising from data sources, the objective of the thesis was, among other things, to contribute to the debate around the impact of technology and to highlight areas for further research. Nevertheless, in acknowledging the importance of technology an attempt has been made to incorporate technology explicitly in the analysis of the determinants of health care expenditures. Despite the complexity of the issues surrounding technology, two potential proxies – rate of growth in pharmaceutical expenditure, and prices of health care goods - were suggested as ways to provide estimates of its impact on health care expenditure.

7.2.2.4 Measuring Health Prices

The thesis has criticised the use in the literature of health prices. A number of important conclusions were also reached with regards to the importance of prices and the relative price of health care. For instance, omission of a price variable might affect the value of the income elasticity of demand. Similarly, the relative price of health care in pooled cross-sectional and time-series analysis is a key factor as price movements are important determinants of changes in health care expenditures. The thesis makes use of price indices which capture movements in prices of health goods and services over the period under investigation, in order to enable dynamic effects as well as technological innovations to be represented adequately.

7.2.3 Conversion factors

The thesis has discussed the validity of different conversion factors employed in cross-country comparison, sharply criticising the use of exchange rates and PPPs (Health- and GDP-PPP). Whereas exchange rates have also been criticised widely in the literature, by default the use of PPPs has been widely accepted. However, the thesis has shown conclusively that Health-PPPs are severely biased towards pharmaceuticals whilst, at the same time, they cannot capture the extent of innovation because they are static over the short-term as they are not updated annually, but only once every five years. Empirical research has also shown that results are often sensitive to the choice of conversion factor. This leaves the health expenditure-related variables without a credible deflator over time that would produce comparable health expenditure data in different countries. Given that neither exchange rates nor purchasing power parities enable a robust comparison across countries, the thesis has not used any of these in the empirical analysis and has resorted to all financial variables being expressed in national currency units (NCUs) deflated by the 1995 GDP deflator in each country. This has also meant an important deviation from the previous paradigm of cross-sectional or pooled cross-sectional analysis, as elaborated below.

7.2.4 Estimation methodologies

The thesis has assessed the relative advantages and disadvantages of different estimation methodologies (cross-sectional, pooled cross-sectional, and time-series analysis) used in estimating the importance of different variables as determinants of health care expenditures.

With regard to the estimation methodology it is important in any econometric modelling to provide a comprehensive understanding of particular sequences. It has been argued that it is doubtful whether this can be done in cross-sectional studies and the value of reducing institutional developments to a dummy variable in either cross-sectional or pooled cross-sectional analysis is questionable.

The thesis has thus supported the use of individual country time-series analysis to address the question of the determinants of health care expenditures, on theoretical and conceptual grounds. Through time-series analysis for individual countries, it has become possible to explore the long-term relationships between predictors of health expenditures at country level. The methodology used in this thesis looks at the health production function within each individual country over a predetermined period without converting economic variables into a common currency. It therefore avoids the methodological problems that both the use of exchange rates and Purchasing Power Parities (PPPs) present in similar analyses for both macroeconomic and health indicators without sacrificing the possibility of comparing results across countries for similar variables. It also avoids the methodological problems arising from the same variables being collected and/or reported in different ways in different countries. Finally, by studying individual countries, time-series analysis also enables policy conclusions specific to particular health systems to be drawn.

7.3 Theoretical contribution

The thesis has argued that there is no existing theoretical or conceptual framework on which to base the health expenditure - income relationship; one can seek a relationship between health spending and any other macroeconomic variable and still come up with statistically significant results. The empirical analysis that has hitherto taken place and was reviewed in chapter 2, is therefore *ad hoc* and does not *per se* add to the existing pool of knowledge. Furthermore, there is very little analysis or theory of what actually determines health spending; rather, there is an *ad hoc* use of those factors which can be measured and are thus readily available for econometric analysis.

Having recognised the absence of an analytical framework, the thesis has provided the theoretical arguments for the treatment of health care systems and the determinants of health care expenditures on an individual and intertemporal basis. The theoretical approach presented in chapter 5 of the thesis deviates from the existing literature of the determinants of health care expenditures in a number of ways.

First, it proposes a conceptual framework that explicitly links the determinants of health care expenditures to the theory of public finance, and allows flexible adjustments by decision-makers to account for changes in technology, population structure, prices, and the macroeconomic environment. The conceptual framework recognises that budgets for health care may need to be adjusted over time because of these changes. Their extent will determine the optimal size of the "health budget". In doing so, the thesis assumes that health care is at least a quasi-public good.

Second, the analysis explicitly attempts to assess the impact of the macro economy on health spending in two different ways. First, it investigates whether the *rate of growth of income* in the economy has any influence on the demand for health. Second, it investigates whether each country's public finances impact on health spending and to what extent.

Third, the proposed framework attempts to incorporate technology in order to analyse its impact on health care expenditures. This is an advance from the published literature, which has almost invariably considered technology as a residual factor. In particular, the impact of technological change is investigated in two separate ways: first, as an expenditure effect, thereby incorporating prices and volumes, and, secondly, as a price effect, analysing the impact of prices of health care goods and services over time on health care expenditures.

Fourth, it recognises that the lag structure of the model, the availability of data, and knowledge of the relationship between disease and need for services are not sufficient to test for the impact of lifestyle and disease factors on health spending. Unfortunately, there is no means currently available to test this complex relationship. This is clearly a gap, which future research and policy needs to address.

7.4 Empirical evidence

The thesis highlighted the limitations of the empirical literature in explaining the inter-temporal variation in health care expenditures and suggested a number of alternatives which were subsequently tested in each of the (13) countries analysed for a 39 year period. The analytical methodology therefore pursued a country-by-country investigation on a time series basis, rather than a cross-sectional or a pooled cross-sectional analysis.

Conclusive evidence is provided on the non-importance (and, very frequently, irrelevance) of GDP in explaining part of the variation in health care spending over time, as well as the value of the income elasticity of demand. While the available empirical evidence suggests that GDP is an important determinant of health spending, the present investigation has concluded that its significance has been at best overrated and in many countries fails to explain any of the variation in health spending over time. In the majority of countries examined, the value of the income elasticity of demand is significantly lower than unity, implying that health care is a normal rather than a luxury good. Similar results emerge for the rate of growth of GDP. Both results question the appropriateness of GDP in (partly) explaining health spending and stress the need for alternative macroeconomic variables that are more relevant to the health care sector.

In addition, the thesis has confirmed a number of observations and arrives at a number of conclusions in relation to policy on cost containment in health systems. As expected, the results vary by country, which is an effect of different organisation and delivery mechanisms as well as different needs across countries. However, some major trends have been identified as follows:

- First, consumption is found to be a generally weak predictor of health expenditures;
- Second, technology is an important cost-push factor in some countries.
- Third, the cost of human resources versus the cost of technology has been evaluated with the use of average wages in the health sector. Ceteris paribus, average wages have exerted a significant upward pressure on health care costs in most countries, with few exceptions. In the former, the positive contribution of wages to health care costs is associated with a relative reduction in hospital costs, possibly indicating a cost-saving technology; in the latter, the static downward pressure of wages on health care costs is associated with a relative increase in hospital costs, indicating cost-increasing technology and the preponderance of technology over human resources.
- Fourth, the macro economy exerts, in general, significant pressure on health care expenditure, as indicated by the fiscal stance variable.
- Fifth, the impact of health care reforms, as expressed by dummy variables in specific countries, appeared to be weakly and positively associated with health care expenditure, though not statistically significant.

- Finally, the number of doctors per capita appears to have little or no association with health care expenditures, with the exception of Finland and Spain, where positive and statistically significant associations were found.

7.5 Policy relevance

The thesis has acknowledged the absence of policy-relevant results from the empirical literature. The main finding from that literature, that health care is a luxury good, has also been left without policy interpretation. The exception, perhaps, was the interpretation that if health care is a luxury good, the marginal units purchase care rather than cure. However, it is questionable whether a cross-sectional or pooled cross-sectional analysis of many countries can lead to any specific policy conclusions at national (system) level. Cross-sectional and pooled cross-sectional analysis brings together countries with vastly different backgrounds and efforts should be made to take into consideration measurement differences and other methodological imprecisions. In that respect, the available empirical literature, provides little insight for policy-making.

By identifying a country-by-country model that helps explain the determinants of health care expenditures, the thesis has also contributed to the policy debate: first, because the analysis is conducted at national level, thereby all estimates are relevant to the policy-making community of each particular country. For instance, the finding that health care is a normal rather than a luxury good over time implies that, despite cyclical or countercyclical pressures on the macro economy, health care expenditure is increasing in line with national resources. This is quite different from health care spending increasing faster than national resources over a period of time; in this case, remedial action may be needed at the macro as well as the micro level, whereas in the former case, remedial action may only be needed at the micro level.

Second, by measuring individual variables, the thesis has provided estimates of their importance at national level, which can subsequently be taken further by decision-makers. Third, a comparative element has also been included in the analysis in that the same model applies to the 13 different countries and for the same time period, thereby allowing policy conclusions to be drawn on the relative importance of individual determinants on a country-by-country basis.

7.6 Limitations and further research

In pursuing an aggregate (macroeconomic) type of analysis, its limitations are recognised. The thesis has not addressed the question of the discrepancies between income elasticities of demand in macro- and micro-economic studies, but the gaps and inconsistencies that the literature on aggregate demand for health care has revealed. To that end, the thesis has used the same or similar data sources as those used by other researchers, but it also points to gaps in these data sources. The limitations briefly outlined below, can serve as the basis for future research.

First, most, if not all, of the empirical studies to date appear to have been driven by the availability of data. This begs two related questions: first, can the available data be better utilised so that they can make more sense for policy development? Second, what improvements might we need in order to better analyse and understand the determinants of health care expenditures and for that analysis to make sense for the development of a policy agenda? The thesis has argued that better estimates of health expenditure figures, national income figures, technology figures, lifestyle data, but, also, measurements of health status are needed. Identifying data sources, and generating and collecting the relevant data is an issue not only for researchers but also importantly of national governments and international organisations.

Second, aggregate income, consumption, public debt and total public expenditure may provide the key to the evolution of a country's health spending; however, the thesis has strived to show that there is an additional series of variables that provide the usual above trend rise in health expenditures. These variables may include the impact of patient satisfaction with the health service, patient expectations and the pressures that these impose on the funding of the health service; measurements of "health", and the impact of new technology, viewed both as a small ticket and as big ticket technology. The thesis has also argued that the implicit assumption of linear improvement in technology development is not valid. Incorporating the above concepts in empirical research, desirable though as it may be, would imply the need for better data sources.

Third, we need to better understand the impact of the determinants of population health, the mechanism through which they operate, as well as improve the collection and reporting of data over time.

Finally, a further understanding of the nature and extent of the informal (but legal) sector and the impact it is having on individual income and health spending also needs to take place. This is because the informal sector contributes to national income in many OECD countries and the majority of developing and transition countries quite significantly. Few studies exist that measure this problem, and even fewer have attempted to demonstrate the way the informal sector contributes to national income. An additional area of research is the way income from the informal sector finds its way into health services and health care delivery. Initial studies based on anecdotal evidence and household-level research have demonstrated the existence of this phenomenon (Lewis, 2002; Anderson, 2000; Delcheva et al, 1997; Gaal, 1998), but have not quantified it at aggregate level.

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